The Electrical World.

VOL. XXVI. NEW YORK, SEPTEMBER 7, 1895. No. 10.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the United States, Canada or Mexico; other foreign countries, $6.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXVI. NEW YORK, SEPTEMBER 7, 1895. No. 10.

CONTENTS.

Editorial 253
St. Louis Electric Combinations 255
The Washington-Baltimore Railway 255
The Gorge Railway at Niagara Falls 255
The Cost of Electrical Energy 255
More Chips from a True Workshop, by Leonard Paget, Ph. D 256
The Invention of the Electromagnetic Telegraph—IV., by Rudolf Petsch 257
Economic Size of Feed Wires for Electric Railways, by W. F. C. Hasson 260
Electrodynamic Machinery—XLVI., by Edwin J. Houston and A. E. Kennelly 261
An Electrical Phenomenon 263
Digest of Current Technical Electrical Literature, compiled by Carl Hering 264
New Books 270
Capital and Labor 270
Automatic Cut-off Rotary Engine 270
DEPARTMENTS:
Financial Intelligence 271
Special Correspondence 271
General News of the Week 272
Trade and Industrial Notes 275
Business Notices 275
Illustrated Record of Electrical Patents 275

THE DOUBLE TROLLEY IN JAPAN.

As we go to press the news reaches us from Japan that the municipal authorities of Tokio, in accordance with the recommendations of a committee of scientists and chiefs of municipal departments, have decided to avoid the electrolytic corrosion of the existing water pipes and interference on the single-line telephone circuits by compelling the use of the double trolley over the projected 85 miles of roads in that city. This is an example of choosing the easiest way out of a difficulty—a mode of procedure too often resorted to at the expense of those more closely interested than the ones whose decision must be accepted. As far as recognizing the principle that the telephone interests have a prior right to the earth is concerned, the decision marks a decided retrograde step, while the assumption involved that pipes cannot be preserved from the effects of corrosion by circuits from single trolley lines is, in the light of our present knowledge, far from being substantiated.

PLANTÉ AND PRACTICAL SCIENCE.

Planté is probably usually regarded as one who confined his work entirely to the sphere of the pure savant, but the communication from his pen, which we printed several weeks ago, and those appearing in the present issue, show him in a different light. From these "Chips from a True Workshop" it will be seen that the French scientist did not disdain to enter the field of industrial development, and even took out a patent, which latter act a few years earlier would have been considered, by his surroundings, as an unpardonable offense in a French savant. From the previous article in our columns it appears that at least as early as 1884, Planté had experimentally determined the constants of the plate which bears his name, a late recognition of the bearing of which data has resulted in again bringing the solid lead plate to the fore. He demonstrated that the Planté plate is not one of inherently small capacity, and early pointed out the direction in which it could be improved. It is unfortunate that the results of his experimental work was not promptly communicated to the technical press as determined. Though part of it seems to have appeared in the *Comptes Rendus*, much was probably not published, or formed the subject of correspondence which did not appear in print at all, or, as in the case of the letters to Dr. Paget, were only published at a day when much of the value had been discounted by later work that might have been spared.

ELECTRIC LIGHT CONVENTION EXHIBITION.

The proposal to hold a special electrical exhibition in connection with the coming convention of the National Electric Light Association, should meet with the favor of electrical manufacturers and supply dealers. An electrical exhibition has come to be recognized as almost a necessary part of the annual meetings of the Association, and it will be especially appropriate to signalize the return of business prosperity by a special effort in this direction at the convention to he held early next year. Aside from this consideration, however, it is well to afford an opportunity at certain intervals for a general view of the state of an industry as progressive as that relating to electric lighting, and the proposed exhibition will serve an admirable purpose in this respect, particularly if the manufacturing companies will assist by contributing exhibits of the latest types of machinery. During the last few years many notable innovations have been made, some of which are just entering into practice, and much good could be accomplished by practical

exhibits relating to these. Arrangements, for example, could doubtless be made that would enable visitors to see in working operation the several alternating systems for combined distribution of light and power, and much skepticism dissipated as to their practicability by actual demonstrations of the effect of unbalancing on two- and three-phase systems. Owing to the unfortunate statements of partisans of the rival systems, much misconception exists as to this point, and such a feature of the exhibition would accomplish a much desired end in correcting it. A collection of the latest types of arc machines would also be interesting, for though one or more of these would be familiar to perhaps all of the members of the Association, a complete exhibit would afford a means of comparison that otherwise might not be within the reach of many. The latest practice in switchboard work, which is beyond the scope of usual convention exhibition, might also be exemplified, and exhibits included of models and specimens of conduits and subways for underground distribution. As will be seen, the field for a general exhibition is a wide one, and the value of that proposed would be so much greater than the usual one confined to materials and smaller appliances, as to amply justify its undertaking by the Association.

UNDERGROUND CONDUIT ELECTRIC RAILWAYS.

A public statement was made last week by officials of the Metropolitan Street Railway Company of New York City, to the effect that all of the cable and horse railways controlled by that company will be equipped for operation by electric power. This decision was the result of the great satisfaction given by the Lenox Avenue road, which for several months has been operated on the Budapest underground conduit system, and has demonstrated a saving of four cents per car-mile over cable traction and eight cents over horse traction. The announcement thus made may be considered to definitely establish the status of underground conduit working, which will, with scarcely a doubt, soon supersede cable traction throughout the United States, and also lead to a considerable extension of electric traction in our larger cities. It may be added that there is a rumor that the Eighth Avenue line is to be equipped with the system that has shown such surprising results. While the Lenox Avenue road has not yet been subjected to a trial of Winter weather, the fact that no particular trouble in this respect has, during the last five years, been experienced in Budapest is sufficient assurance. The question as to trouble from moisture formerly thought to be inseparable from an open conduit system has been the crucial one, and is now happily settled. The simplest system of underground conduit electric traction having been demonstrated to be entirely satisfactory, one cannot help but reflect upon the immense waste of ingenuity, and the great expenditure of money and time, on complicated systems devised to obviate difficulties that never had any practical existence. The number of such systems that have been invented probably number considerably over a thousand, and it is curious to note how in many the very evil it was designed to obviate was accentuated. In one class side conduits and other traps for moisture were substituted for the simple open conduit, and in others mechanisms introduced at frequent intervals which in themselves were sources for leaks through the collection of moisture, and additionally objectionable from the complication involved. The success of the underground conduit system is not, however, an unmixed good, as it may lead to a crusade against the overhead trolley in some cities, and delay the extension of electric traction in others, through attempts to require the installation of a conduit system where the conditions would not justify the great expense entailed. As the public now probably recognizes that not the "deadly trolley," but the high speed demanded by the public itself, is the cause of the increased deaths in the streets resulting from the introduction of electric traction, the argument against the trolley will be substantially on the grounds of disfigurement of the streets, and may be partly met by the adoption of a pole line construction of more graceful appearance than now usually employed. It is fortunate that the demonstration of the success of the conduit system was delayed until the overhead trolley had pretty generally occupied its field. If, as has been charged, it had been purposely kept in the background, the public no less than the electrical industry has been benefited, for otherwise complications would have ensued largely curtailing the benefit now being derived so generally from electric traction.

FORMULAS.

In an article printed elsewhere in this issue Mr. W. F. C. Hasson gives a method employed by him in calculating the economic size of feed wires for electric railways, which, though not new in principle, is interesting as an application of such a calculation to a specific case. The author refers to the unsatisfactory and perplexing results obtained from the various existing formulas on the subject, which is doubtless an experience all have had in dealing with formulas, and leads to the consideration whether it is not always better to commence with first principles in any case and calculate the formula for that case, rather than depend upon one ready made. Formulas may be classed in two categories—those deduced from general principles and others merely empirical, representing the results of what has been found good practice in a greater or less number of cases. An objection to the former is that they frequently contain factors, as found by Mr. Hasson, which need not be considered as variable in a given case, and, therefore, their form for such a case is not correct, or, in more general terms, the assumptions made in the first instance may not apply to a particular case under consideration. As to the second class, their use is valuable in workshop practice when they have been constructed to represent the results of practice there, but otherwise should be regarded as "not proven" until thoroughly tested with respect to the employment to which they are to be put. Fortunately the latter class has been greatly restricted in electrical engineering, which branch has thus escaped the evils to which other branches of applied science, and particularly mechanical engineering, have thereby been subjected. As a rule, it is very easy, with a knowledge of the principles involved, or the assistance of a text-book or other treatise containing a statement of them, to calculate a formula for a given case, and has the very great advantage of leading to each factor being considered with reference to that case, and not with reference to a general consideration that may be entirely absent or only apply in a special sense. If a substitution in such a formula does not give a reasonable result, one is not entirely helpless, but can probably readily determine which factor is at fault by reference to the process by which the formula was built up. The history of the formulas for the most economic size of wires in electrical distribution illustrates the undesirability of using such deductions without examining into their applicability. When first enunciated by Sir William Thomson, it was accepted in the general form given, but soon after Forbes showed that for the case of underground conductors additional factors entered, and almost every writer on the subject has since established variations in its form for particular cases. Text-book writers would accomplish a good purpose by stating clearly the principles upon which a formula for a given purpose is based, and then proceed to build one up, with the warning that it is only true under the special conditions assumed, and accompanying it with a discussion as to how its form would be affected by other possible conditions. This would result in creating more respect for "theory," and also furnish the student in after years the necessary information to which to refer when considering a practical case.

St. Louis Electric Combinations.

It is pretty well settled that the Edison Electric Illuminating Company will absorb the Laclede Gas Light Company of St. Louis. The latter has virtually a monopoly of various departments of the illuminating business there, owing to the provisions of its charter. The Edison, the Missouri, and the Municipal electric lighting companies are already consolidated, and if the Laclede is taken into the combine the business in St. Louis will all be under one management. James Campbell, one of the largest stockholders in both companies, is now in negotiation for this purpose with Emerson McMillan, of New York City, president of the Laclede Company. The contracts for lighting the city with electricity will expire in 1900 when new bids will be received.

The street railway men of St. Louis no longer deny that they are perfecting arrangements looking to a final consolidation of traction interests. It will take a capitalization of about $50,000,000, which the State law at present prohibits corporations from having, the maximum being $10,000,000. But a great deal is expected of the legislature, and a system of "education" among the people is already being prosecuted to convince them that amalgamation would be the best thing for the public.

The Washington-Baltimore Railway.

Mr. David M. Newbold, the president of the proposed Washington & Baltimore electric road, which has recently obtained control of the Eckington and Belt Line railways of Washington, is reported as having said that work upon the Washington & Baltimore Railway will soon begin at both ends of the line simultaneously, arrangements to this end having already been perfected.

Mr. Newbold states that his road acquired a controlling interest in the Eckington and Belt Line roads in order to give the Washington-Baltimore line entrance into this city, as well as for the purposes of local transit. The managers of the company, he says, fully recognize the existing prejudice against trolley lines for city service, and will, therefore, adopt some other electrical system for that portion of the line which is located within the city limits. Just what system is being considered is not made clear, but the impression prevails that a plain conduit arrangement will be adopted, somewhat similar to that recently put into service on the Lenox Avenue line in New York.

The Gorge Railway at Niagara Falls.

Work on the Gorge Railway is progressing rapidly and the road is fast nearing completion. The double track has been laid from the terminus to the Buttery Elevator, and it only remains to ballast about half a mile of the roadbed and put down the heavy guard rails to complete this section. The work between the Buttery Elevator and Third Street is also well under way, and the grading between the cantilever bridge and the Ingles Cut is nearly completed for the double track. The tracks will be carried around in front of the cantilever bridge piers on a substantial iron bridge supported by two heavy abutments and a stone pier, the excavations for which are now completed.

The new cars for this road were built with special reference to speed and perfect safety, the wheels having a three and a half inch tread with three-inch flanges, making it next to impossible for the cars to leave the track. Each car is also provided with three brakes —a safety, air and trolley brake. As soon as the road is thoroughly in order for car service, regular trains will be placed on the line and a dummy engine burning hard coal will be used until the Schoellkopf power plant is ready.

Resuscitation from Electric Shock.

On Wednesday of last week, H. W. Sherman, an employee of the Rochester Gas & Electric Company, while on a roof adjusting some wires, received a shock from a 2,000-volt circuit. Two of the linemen who were with him immediately proceeded to put into effect the process of artificial respiration, and six minutes later the man was brought to consciousness.

The Metric System for England.

The committee appointed by the Rosebery Government to consider and report on the subject, has issued a report, recommending that the metric system of weights and measures be immediately legalized, and that the use of the system be made compulsory after two years.

The Cost of Electrical Energy.

Referring to a statement that the price of current from English stations may be reduced to six cents per kilowatt-hour, the London *Electrical Engineer* says that in its opinion it is altogether bad to make statements of this kind. Ignorant people fasten on them, especially as the ordinary newspaper sub-editor revels in giving them a corner, and thus hundreds, if not thousands, are led to expect something altogether impossible in the majority of cases. It does not say that it is impossible here and there to produce electrical energy so that it may be sold at the price named, but it does say that in the majority of cases at the present time it cannot be done, and there is no likelihood of its being done during the lifetime of this generation. It is the average cost and the average selling price that should be the guide, rather than the lowest possible cost and the lowest selling price under the most favorable conditions that can be obtained. It is extremely annoying for a canvasser who calls upon the householder to ask him to introduce the electric light to be met with questions about the exceedingly high price at which the company or the municipality he is canvassing for charge for the energy supplied. The canvasser is met with the statement that such-and-such an authority says the price to large towns ought to be six cents per kilowatt-hour, and here you are charging six, eight, ten and twelve cents or more. These charges may be low when all the conditions are taken into account, but the householder is not the person to trouble himself about the existing conditions. He merely thinks he ought to get it at a certain price, and is annoyed to think that he cannot get it at that price, and refuses to patronize the new light. The majority of towns in the British Isles are compelled to fall back upon steam or gas engines as the motor for driving the dynamos. They have no water power available, hence the cost of generating a unit of electricity will probably be much larger under these conditions than for a town where water power is handy and otherwise running to waste. A careful examination of the cost of generation in the stations of the companies and the municipalities will show that in very few instances is the actual cost of generation below the selling price suggested; but there are other expenses to be met besides the absolute cost of generation, and, roughly speaking, the selling price should never average less than double the cost of generation. Our English contemporary directs attention to this subject at once, in the hope that a general refutation of its possibility will do something to ward off the harm that such a statement might lead to if left unnoticed.

Central Station Design.

Our English method, says the London *Electrical Review*, of electric lighting committees making a round of inspection of several central stations on different systems, endeavoring to collect as much information and data as they can, which generally amounts to as much as the engineer in charge cares to give, returning to their native town with their heads stuffed full of figures, volts, watts, amperes, etc., and then taking upon themselves the responsibility of recommending this or that system as being best suited to their wants, is suicidal. The money spent on these rounds of business, mingled with pleasure, would in many cases pay for a report by one of the most eminent specialists in the profession. The committee would thus be relieved of much responsibility and subsequently the chagrin at having been connected with the promotion of a concern which is no credit to them either from a mechanical or commercial point of view. If economies are to be practiced in a central station, let them be started at the very beginning. Before taking any definite steps, call in the impartial consulting engineer, be guided by his experience and advice, get a plant which will be a success all round, a credit to the town or city, and a pleasure to the engineer in charge and his men to run, instead of having to make the best of a bad bargain, and be left far behind in the race for economical working.

Consolidation of Chicago Electric Railways.

A New Haven newspaper contains a dispatch from Chicago, dated Aug. 27, stating that "Messrs. Elkins and Widener, representing the Philadelphia syndicate which owns most of the street railways in New England and now proposes to run a through trolley line for freight to most of the leading cities of the eastern middle states, have practically arranged to get control of all the electric lines in Chicago. They will run a trolley line to New York for through freight, connecting with other lines, which will haul cars to New England cities."

More Chips from a True Workshop.

BY LEONARD PAGET, PH.D.

So many of my electrical acquaintances and friends have expressed appreciation of the publication of one of Planté's letters in the issue of The Electrical World for Aug. 10, as to cause me to accede to their request for more of these chips from such a workshop.

Planté's figures show very conclusively that for a given weight of plate the capacity in ampere-hours he obtained was not at all a small one. It has, however, been the fashion to regard a Planté cell as one of inherently small capacity. But we learn from the letter that has just been published (and dated June 16, 1886), that Planté obtained 60,000 coulombs, "or more than 16 ampere-hours" per kilogramme of lead. This corresponds to 7.257 ampere-hours per pound of lead, a capacity that is not exceeded in any battery of like type upon the present market.

It is also supposed that this high capacity was attainable only by a long and tedious process of formation. In fact one of the advocates of the Planté cell, who put several modifications upon the French market, proved very clearly that long and careful reversals of current were necessary to form a lead plate to its full capacity, for he showed that charging and discharging a lead accumulator for long hours produced very slow results. Here are some of his figures:

Hours.	Coulombs.
75	5,000 per kg of lead.
100	5,500 " "
500	12,000 " "
1000	19,000 " "
2000	34,000 " "
3000	49,000 " "
4000	64,000 " "

These figures are very interesting because they show that although the formation is slow at first (25 per cent. increase of time producing only 10 per cent. increase of capacity), that subsequently twice the time nearly doubles the capacity.

It was to overcome this initial slowness of formation that Planté constantly experimented. It is not true that his accumulator was always regarded by him (nor by others, for that matter) as requiring long periods in forming, for as early as Aug. 28, 1882, he communicated to the Academy of Sciences of Paris, a paper, entitled "On the Formation of Secondary Couples with Lead-plates." This paper reads, translated, as follows:

"The operation I have designated under the name of *formation* of secondary couples, consists, as I indicated several years ago (*Comptes Rendus*, lxxiv., p. 592, 1872), in a previous electrochemical preparation of these couples, having for its object to deeply oxidize one of the electrodes, and to reduce the other to a state of metallic division that permits of more complete chemical action during the charge and discharge, and of accumulating, consequently, a greater quantity of the chemical work of a primary current.

"I have sought, since then, to perfect this operation. Studying the chemical actions that are produced in these couples, I have observed especially the transformation of a part of the peroxide of lead into sulphate of the same metal, under the action of the solution of sulphuric acid in which these couples are immersed (*Les Mondes*, xxvii., p. 425 to 477; 1872), a result recently confirmed by Messrs. Gladstone and Tribe, in an interesting work on this subject. I have attempted to increase the capacity of accumulation, by producing a previous galvanic deposit on the lead of the electrodes (*Les Mondes*, *ibid.*), in such a manner as to cause subsequently a deeper oxidizing action of the primary current by reason of the exceptional porosity of electrochemical deposits. I have tried, to this end, the most varied combinations, and for the most part of insoluble and soluble compounds of lead, without obtaining any deposits of a sufficient coherence or adherence, and in which the electric contact with the electrodes would remain indefinitely insured. I have arrived finally at this conclusion, that the preferable system was to seek to transform the metal of the electrodes itself, in nearly all its depth, into galvanic peroxide of lead, on the one part, and into reduced lead, on the other part. I obtained this result by a series of changes of direction of the primary current, with intervals of repose between these changes ('Recherches sur l'Electricité,' § 53, *et seq.*).

"To give an idea of the effects obtained by this method, I should add that with a secondary couple already partially formed, and in which the lead weighed 1.5 kg, the discharge current, which initially furnished a deposit of about seven grammes in a voltameter, gave, after a fresh change of direction, a deposit of 11 grammes, and, after an interval of rest and another change of direction, a deposit of 18 grammes, or 12 grammes per kilogramme of secondary couple, which corresponds to 36,000 coulombs.

"This is not the limit that can be attained, because a fresh change of direction determines a further increase of accumulated chemical work, and so forth. There is no other limit than the thickness of the plates of lead. Admitting that we seek to transform only one half the thickness of metal, and to preserve the other half as the body of each electrode, and even assuming that the peroxide is reduced, during discharge, to the state of protoxide only, we should hope to obtain, by this method, a discharge current sufficient to deposit, per kilogramme of lead of the secondary couple, about 75 grammes of copper, which represents a rather considerable quantity of electricity.

"This system of changes of alternated directions has not only for its effect to increase successively the layer of peroxide of lead formed at the expense of the metal of one of the electrodes, but also to transform, to a corresponding depth, the other electrode into galvanically reduced lead, so that, during the discharge, whilst the hydrogen, provided by the decomposition of the water at the interior of the couple, reduces the peroxide of lead formed by the primary current, the oxygen oxidizes at the same time an equivalent quantity of lead.

"We may explain also the efficacy of the intervals of rest between each change of direction, by considering that at the end of a certain time the plates of lead thus modified have become less good conductors at their surface. It results that, when we submit anew to the action of the primary current, this current will naturally follow, in order to traverse the liquid, the path of least resistance; it will not issue directly by the oxidized surface, but by the subadjacent metallic surface as far as where the liquid may have penetrated. It thus oxidizes by the mere fact of its passage, a new layer of metal, or it may also superoxidize little by little, the external surface already oxidized, or effect the inverse work of reduction, if the direction of the current has been changed. . . .

"This method requires without doubt a rather long time, especially at the commencement. To facilitate the attack of the lead by the electrochemical action of the primary current, I have succeeded by elevating the temperature of the liquid of the secondary couples, either previously to or during the action of the current, in accelerating their formation. But this employment of heat presenting some difficulties in practice, I have had recourse, finally, to another procedure, which has given very satisfactory results.

"This process consists in simply submitting the secondary couples to a sort of deep pickling in nitric acid, diluted with one half its volume of water, and allowing them to be immersed in this liquid during 24 to 48 hours. The couples are emptied, washed very thoroughly, and filled with water acidulated with one tenth of sulphuric acid, and submitted to the action of the primary current. By this immersion in the diluted nitric acid, a portion of the lead is doubtless dissolved, but the thickness of the plates is not notably diminished, and, by consequence of the metallic porosity, the chemical action takes place not only at the surface of the lead plates but also at the interior, creating new molecular spaces and facilitating consequently the ultimate penetration of the electrolytic action of the primary current.

"Secondary couples thus treated will furnish in eight days, after three or four changes of direction of the primary current, discharges of long duration, such as, without the previous action of the nitric acid they would give only after several months. . . ."

A modification of this method was also discovered and applied by Messrs Elwell and Parker, of England, who sought to obtain a consolidation of interests with Planté, for he writes subsequently to the author of this paper as follows:

(Translation.)

Paris, 56 Rue des Tournelles.
26 June, 1883.

Dear Sir:—I am in receipt of your letter of 21st and 23d, current, which last contained a statement as to Messrs. Elwell and Parker, that you ask me to explain to you.

These gentlemen having taken in the month of August of last year, three weeks after me, a patent analagous to that which I had taken, for the rapid formation of my secondary couples by the aid of a previous treatment with nitric acid, have asked me to cede to them my rights, and they wish to mention my name, in order to recognize that it was very nearly my system that they were employing.

But this will not hinder me taking the greatest interest in the success of the improvements that you have made on the same, and with which you have also associated my name.

Accept, dear sir, the expression of my best devoted sentiments.

(Signed) Gaston Planté.

The Invention of the Electromagnetic Telegraph—IV.

BY RUDOLF PETSCH.

SINCE the discussion which has been started in America concerning the claims of Morse, Vail and Henry to priority in the invention of the first practical apparatus for an electromagnetic telegraph, much interest has been taken in the subject by European members of the profession, although the latter, without exception, have never doubted that the birthplace of the electromagnetic telegraph is really to be found in the Old World.

In order to correct the false impressions concerning this matter, which seem to prevail on the western side of the Atlantic, we will try, supported by the literature of the subject, and by other evidence, to give as complete an account as is practicable of the beginnings of the telegraph and its development until the introduction of the Morse apparatus.

In searching for the origin of technical projects, the question is occasionally raised whether a casually uttered, vague idea, or the later design of a practical working contrivance, perhaps developed from the vague idea, is the real invention. We will, therefore, at once make our position clear by stating our agreement with a remark of Dr. Julius Dub[1] that undoubtedly the credit of the invention belongs to the expert who builds an apparatus whose practical application is plainly visible, and not to him who, without any scientific reason, makes a vague intimation in an uncertain manner.

Concerning the latter, we may refer briefly to the idle dreams of the possibility of a magnetic telegraph, which appeared as early as the 16th century in the writings of an Italian, Joh. Bapt. Porta, and which were mentioned in various philosophical mathematical works until the 18th century, although, owing to their inherent impracticability, the carrying out of these plans was impossible. In like manner, the propositions made in the latter half of the 18th century for utilizing frictional electricity for telegraphic purposes, although resting on a scientific basis, could not be reduced to practice on a large scale.[2]

Without the discoveries of the Italians, Galvani and Volta, at the end of the 18th century, the telegraphic ideas would probably have made no useful progress. On the other hand, the many plans and experiments which suddenly sprang up for using galvanic forces for the distant transmission of intelligence, could only assume practical shape after the important discovery[3] of electromagnetism by the Danish savant Oerstedt,[4] in 1819. This discovery was followed the next year (1820) by the construction of the multiplier by Schweigger, a professor at Halle, and Poggendorf, at the time a student in Berlin, *simultaneously. The multiplier furnished the foundation for the needle telegraph.*[5]

BARON SCHILLING VON CARNNSTADT.

To be sure, Thomas von Sömmering[6] had before this time, in 1809,[7] shown the *first actual galvanic telegraph* in the building of the Academy of Sciences in Munich, when, by means of currents from a powerful voltaic pile, carried on insulated wires, he decomposed water in a glass vessel into which ran all the conductors, ending in golden tips. The 25 gold points of the receiver as well as the transmitter's corresponding contact rods, which were pierced with holes, were marked with the letters of the alphabet. The two gold wires of the pile ended in points which could be inserted in the words corresponding to the characters to be telegraphed. When both points were simultaneously stuck in the holes of two rods, the circuit from the pile was closed through the water in the receiving vessel, the water became decomposed, and as the decomposition is first visible at the hydrogen pole, and the volume of hydrogen set free is nearly twice that of the oxygen, the hydrogen pole was easily distinguished from the oxygen pole, and in deciphering the telegram, *two* letters could always be received simultaneously, that given at the hydrogen pole being regarded as the first.

Sömmering's telegraph, for whose operation the inventor also devised a very ingenious signal,[8] did not come into use on a large scale principally on account of the expensively complicated arrangement of the conductors and the slowness in transmitting characters. In his experiments, however, he worked with longer and longer lines, and on March 15, 1812, he telegraphed through 10,000 feet of wire.[9]

The original apparatus, reproduced in Fig. 1, is still in the possession of the descendants of the inventor, who live in Frankfort-on-Main.

The Russian, I. Hamel, in his work on "The Origin of the Galvanic and Electromagnetic Telegraph," to which we shall often refer in the pursuit of our investigations, gives the following account of the immediate cause for Sömmering's invention:

"In 1809 war broke out between Austria and France. On April 9 the Austrian troops had unexpectedly begun to cross the Inn and so enter Bavaria. King Maximilian, who was allied with France, had hardly received news of this before he hurriedly left Munich with his family on the 11th, and went to Dillingen, on the western frontier of his kingdom. He took with him Freiherr Maximilian Joseph von Montgelas, who occupied a high position in the direction of the affairs of state in the Kingdom of Bavaria.

"By means of the Chappe optical (mechanical) semaphor telegraph, which at that time reached from the French frontiers at Paris, Emperor Napoleon received much quicker intelligence of the advance of the Austrians, than the latter thought possible. He immediately set out to join his army, and at Dillingen he surprised King Maximilian not a little by his entirely unexpected appearance.

"Napoleon's promptness in coming to his army was soon followed by the freeing of Bavaria from the invading Austrians. Munich had been taken by Jellalich on April 16, but on the 22d he was obliged to withdraw, and King Maximilian returned to his capital on the 25th."

These events, so important for Bavaria and its capital, could not fail to call attention to the great utility of the telegraph. Minister

---

[1] Dub: "Die Anwendung des Electromagnetisimus mit besonderer Berueecksichtigung der neueren Telegraphie" (The Application of Electromagnetism with Special Reference to the Newer Telegraphy), Berlin, 1873.

[2] Among others, Lesage (Geneva, 1774) proposed transmitting the letters of the alphabet by means of 24 insulated wires, which were to be excited by frictional electricity, and to make known their signals at the distant end by means of the repulsion of small gold leaves.

[3] The deflection of a magnetic needle by a current of electricity had already been observed by the Italian Romagnosi, in May, 1802, at Innsbruck, but at that time the multiplier was lacking, and, at any rate, the real nature of electromagnetism only became generally known through Oerstedt's experiments.

Besides this, there appeared a book in Berlin, in 1874, attempting to prove that Schweigger, by reason of an observation published in 1808, was to be regarded as the discoverer of electromagnetism (*vide* "Zeitschrift fuer Mathematik und Physik," Vol. XVIII., 1873, page 609.)

[4] Oerstedt, physicist and chemist, professor at the University of Copenhagen; born 1771, died 1851.

[5] "Archiv fur Post und Telegraphie," Vol. V., 1877.

[6] Von Sommering, Samuel Thomas, born Jan. 18, 1755, at Thorn. In 1774 began the study of medicine at Goettingen, where he took his doctor degree in 1778. After this he became professor of anatomy first at Cassel, then, in 1784, at Mainz. After the suspension of the latter university he practiced in Frankfort-on-Main. In 1804 he became a member of the Academy of Sciences in Munich, and was afterward raised to the nobility. In 1820 he returned to Frankfort-on-Main, where he died on March 2, 1830.

[7] "Muenchener Denkschrift der Akademie der Wissenschaften fur 1809-10."

[8] A spoon, concave downward, at one end of a double armed horizontal lever, collects the rising gas bubbles, and after a while is lifted by them. In consequence, the other end of the lever arm sinks, and lets a loosely placed, small metal ball drop from it; this ball falls on a shell fastened to a trigger, and thereby releases a bell-ringing mechanism.

[9] Dr. K. G. Zetzsche, "Handbuch der Electrischen Telegraphie," Berlin, 1876.

Montgelas had been a witness of the surprise at Dillingen. In his charge, among many other things, was the Academy of Sciences, and he often invited Dr. Sömmering, one of its most highly esteemed members, to dine with him at his residence in Bogenhausen. This was the case on July 5, 1809. During the meal the Minister remarked that he would like to receive propositions for a telegraph from the Academy.

I think it probable that Montgelas only intended to occasion improvements in the *optical* telegraphs, which at that time existed in France and elsewhere. Sömmering, however, was struck by the thought of trying whether, through the decomposition of water by the galvanic current, the visible and speedy evolution of gases at gold electrodes could not be used for telegraphic purposes, and he did not rest until he had set to work on this idea.

Three days after the dinner at the Minister's, that is to say, on July 8, Sömmering wrote in his diary: "Could not rest until I had realized the idea of a telegraph by means of the releasing of gas." In other manuscripts of Sömmering I have found that on this day he made the first experiments to try whether letters could be shown at a distant place by means of the generation of gases. For this purpose he used a small battery of fifteen elements (Brabant dollar, felt and zinc). In order to insulate the wires, he drew them through a flame and then over sealing wax.

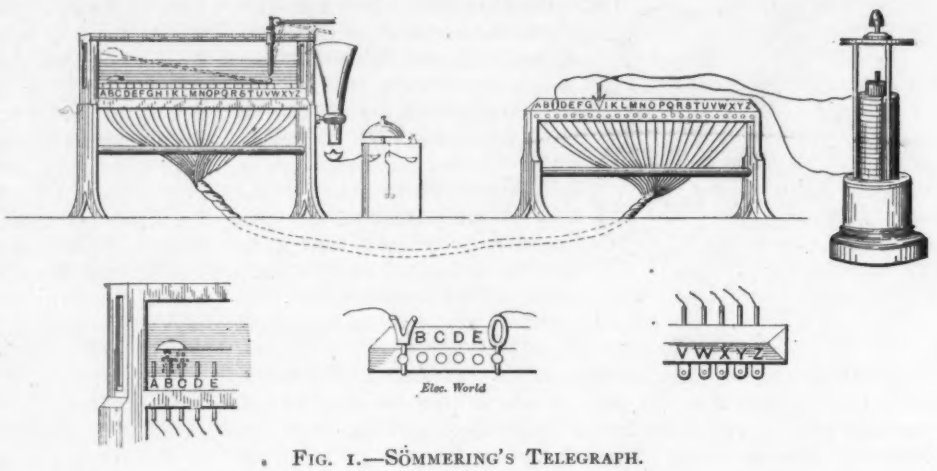


Fig. 1.—Sömmering's Telegraph.

through a thousand feet of wire, and on Aug. 18 through 2,000. On the following day, the 19th, he showed the apparatus to the secretary of the physico-mathematical class of the Academy, Freiherr von Moll, and on the 29th he experimented with the completed telegraph at a session of the Academy.

Sömmering greatly desired to exhibit his telegraph before the Institute in Paris,[10] and a favorable opportunity for this arose when his old acquaintance, the chief medical inspector of the French army, Baron Jean Dominique Larrey, visited him on Nov. 9. Larrey gladly agreed to take the telegraph to Paris, and even helped him to pack it up. Sömmering sent with him a memoir on his apparatus, in which he intimated that he would like to have his instrument shown to the Emperor.

I lately obtained permission to inspect the minutes of the Institute of that time, and I found that Larrey exhibited the telegraph on Dec. 5, 1809. A committee, consisting of Biot, Carnot, Charles and Monge, was appointed to make an investigation of it; but I have been unable to find any report on it, although I have looked through the minutes of nearly two whole years.

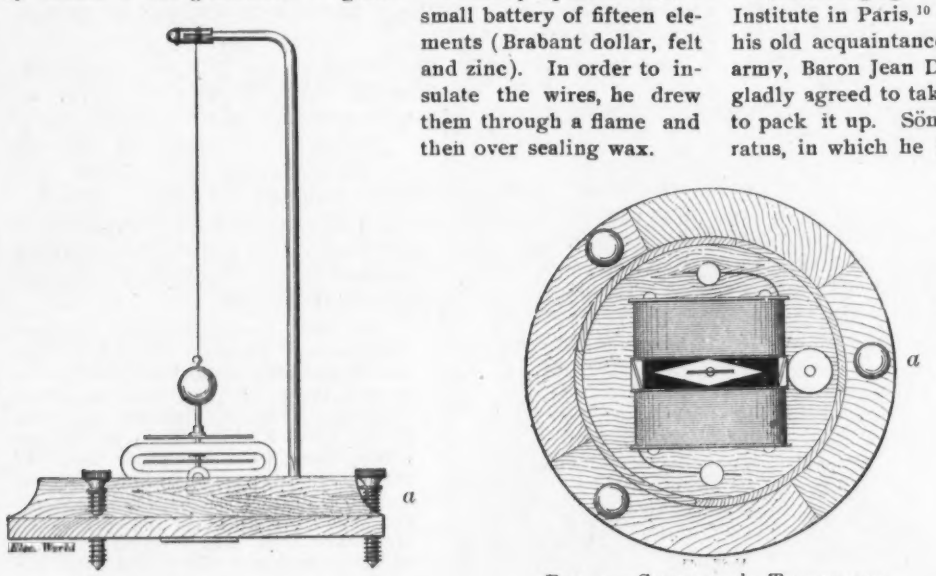
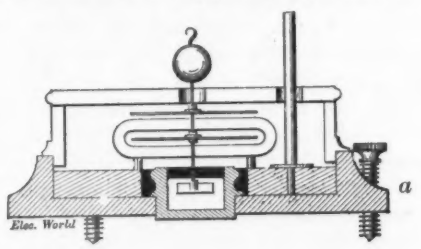


Fig. 2.—Schilling's Telegraph.



On July 22 his apparatus was ready for trial. On this day he wrote: "The telegraph at last completed;" and on a separate sheet there stands, under the same date, "The new telegraphic machine works well." He perfected it, and on Aug. 6 he was able to telegraph through 724 feet of wire. Sömmering wrote on this day, "Tried the entirely finished apparatus, which completely fulfills my expectations." Two days later he telegraphed through 1,000 feet of wire.

The fact that the Chappe mechanical telegraph was already established in France may be the reason why Sömmering's system did not arouse the interest which the inventor expected. He received his apparatus back from Paris only on May 12, 1811.

Sömmering's invention never came into practical use. Besides the care with which it had to be manipulated, the large number of wires necessary was an obstacle, particularly as at that time people

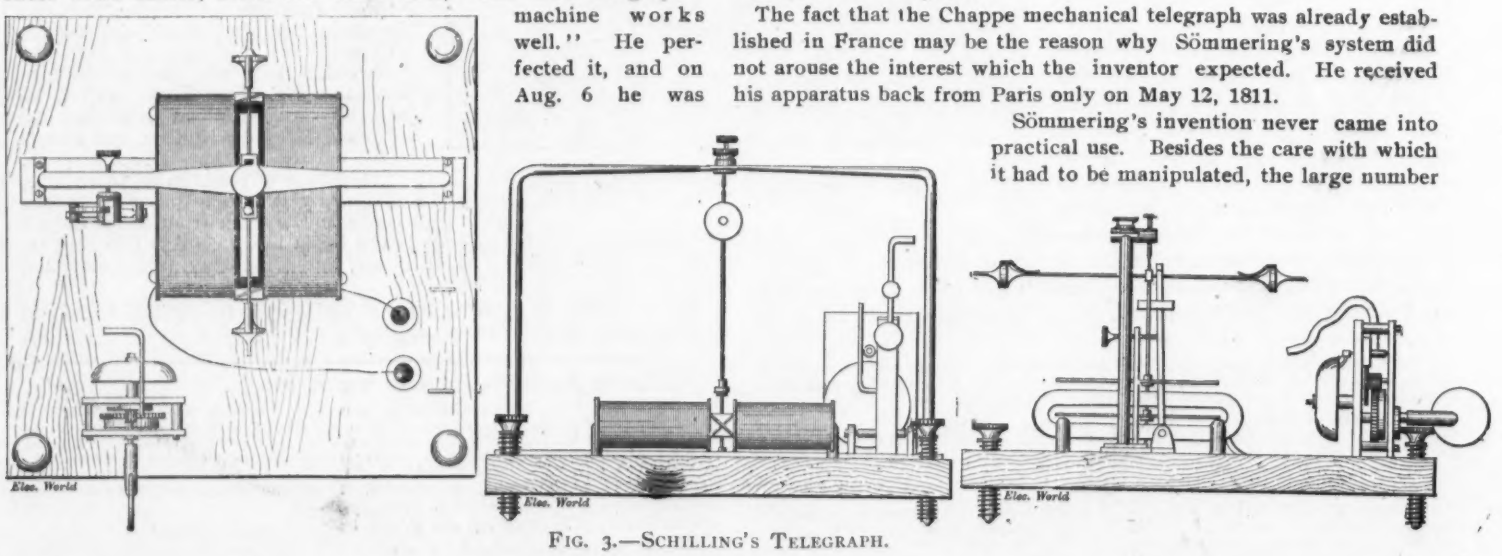


Fig. 3.—Schilling's Telegraph.

[10] As early as Sept. 5 he wrote in his diary: "I think of sending my telegraph to the National Institute in Paris."

did not understand how to insulate them properly for long distances. But even, although propositions for improvement in this respect were made, particularly by Prof. Schweigger in 1811, they were not able to introduce the apparatus into practice. The desire for a

OERSTED.

rapid transmission of intelligence seemed still to be wanting, and when at last it made itself felt, there had already been found easier methods of satisfying it.[11]

The first ideas for an electromagnetic telegraph, which the Frenchman, Ampère, published in the "Annales de Physique et Chimie," in 1820, and the German, Fechner, made public in his text book on Galvanism in 1829, were inherently as unpractical as Sömmering's arrangement, on account of the complicated system of conductors. (Ampère used not less than 60 wires.) Among the systems modelled on Ampère's principle, that of the Englishman, Ritchie, deserves mention, but the next important step made after Sömmering's plan, and the one which first led to practical results in electric telegraphy, namely, the introduction of needle instruments, was due, as has already been mentioned, to the German invention of the multiplier.

Soon afterward, in 1825, *the first horseshoe magnets* were made by the Englishman, Sturgeon,[13] by varnishing a horseshoe-shaped piece of iron wire, and then winding about it a bare copper wire so that the different turns did not touch each other.

The American professor, Joseph Henry, was led to further improvements in the making of electromagnets through his investigations in the years 1828 to 1830. Henry covered his wire with silk and wound several layers over each other, being able, as became necessary, to connect them either in multiple or in series. In 1832 in the Albany Academy, Henry exhibited an *alarm bell worked by electromagnetic attraction*, which he had designed. A magnetic bar swung freely on a pin, and one of its ends was between the poles of a horseshoe electromagnet. The other end struck a bell when the bar was attracted from its position of rest. The conducting wire, running through several rooms, was about a mile long.

Undoubtedly, however, the great credit of proposing a system distinguished from those that had preceded it by its great simplicity belongs to the Russian, Baron Schilling von Carnnstadt,[14] who was a friend of Sömmering's, and who had often taken part in his work described above. Schilling,[14] before the year 1832, developed a plan which was to simplify telegraphy so much that nothing should stand in the way of carrying it out practically. First of all he proposed to employ only two wires (going and returning,) and a single multiplier with a magnetic needle. By means of appropriately arranged combinations of the right and left deflections of the needle, he was able to form all the characters necessary for correspondence.[15]

As he formed each telegraphic character by a certain system of right and left deflections of the needle, he was, in reality, the *inventor of the needle telegraph*, and, *with this, of the first electromagnetic telegraph* which, in slightly different form, has been in operation in England until recently.

An alarm[16] also forms a feature of Schilling's design. He experimented with his telegraph before Emperor Alexander I, and later before Nicholas, but it did not come into practical use, because Schilling died before the arrangements could be carried out.

Figs 2 and 3 show the individual parts of two different forms of the original apparatus, which is in the possession of the Russian telegraph department.

Independently of these experiments, the German professors, Gauss and Weber,[17] had, in 1833, constructed *the first electromagnetic telegraph on a large scale and really put it in operation.* As is well known, in 1832, there had already been constructed new apparatus at the Goettingen observatory, with which the elements of the earth's magnetic force could be determined with far greater accuracy than by the earlier methods.

In order to study further physical questions connected with the new investigations, Gauss and Weber put up a two-wire circuit running from the astronomical observatory and the magnetic observatory 1.5 kilometres over the houses of the town to the physical cabinet. Galvanometers were placed in circuit, and from the beginning were used extensively for mutual telegraphic communications. The circuit was in use until 1838, and was later destroyed by lightning. The currents used by Gauss and Weber were galvanic at first and later magneto-electric. The apparatus in its latest form is still in the possession of the physical laboratory at Göttingen. It consists, as is seen in Fig. 4 and 5, of:

1. The transmitter A'_m (induction multiplier);

VON SÖMMERING.

2. The receiver *M H N* (magnetic bar with multiplier coil and mirror);

[11] "Das Buch von der Weltpost," by O. Veredarius, Berlin, 1885.

[12] Dr. K. G. Zetzsche, "Handbuch der Electrischen Telegraphie," Berlin, 1876.

[13] I. Hamel, "Die Entstehung der Galvanischen und Electromagnetischen Telegraphie," St. Petersburg, 1883. Dub, "Anwendung des Electromagnetismus," Berlin, 1873.

[14] Schilling von Carnnstadt, Russian councillor of State; born 1786 at Reval; died 1837 at St. Petersburg.

[15] He suspended a *horizontal* magnetic needle with a light vertical axis by a silk thread inside a Schweigger multiplier. About the middle of the vertical axis he fastened a disc of thick paper differently colored or marked on its two sides, and at the lower end of the axis was a little vane of thin platinum, which dipped into a saucer of mercury in order to dampen the oscillations of the needle. At first he used five such instruments next to each other, in order to represent the whole alphabet and the figures. But he gradually simplified the arrangement so that he was able to form all the characters with a single apparatus.

[16] "Allgemeine Bauzeitung," 1837, No. 52.

[17] Gauss, Carl Fredrich, born 1777 in Brunswick. In 1807 professor of astronomy and director of the observatory at Goettingen. Died 1855.

Weber, William, born 1804 in Wittenberg, professor in Goettingen, celebrated physicist. He died at Goettingen on June 23, 1891, bearing the titles of "Wirklicher Geheime Rath" and Professor Dr. philosophiæ, medicinæ et juris.

3. The telescope with scale for reading the deflections of the magnetic bar (*Rm*).

In a report on the magnetic observations of Gauss and Weber there is the following words relating to their telegraph:[18]

"With this system there is combined a grand and hitherto unique arrangement of apparatus, which is due to Prof. Weber. As early as last year he ran a two-wire circuit from the physical cabinet over the houses of the city to the astronomical observatory, which has now been continued from the latter to the magnetic observatory. There is thus formed a great galvanic conducting chain, in which the galvanic current, taking the multipliers at both ends into account, has to traverse nearly 9,000 feet of wire. The conductor is principally copper wire of a size designated in trade as No. 3, one metre of which weighs eight grams. The multiplier in the magnetic observatory is wound with No. 14 silvered copper wire, 2.6 meters to the gram. This whole contrivance is entirely fitted to give occasion for a number of the most interesting experiments. It is noticed, not without wonder, how a single pair of plates brought into circuit at one end, instantaneously causes a movement of the magnetic bar at the other end, which rises to a deflection of much over a thousand scale divisions.

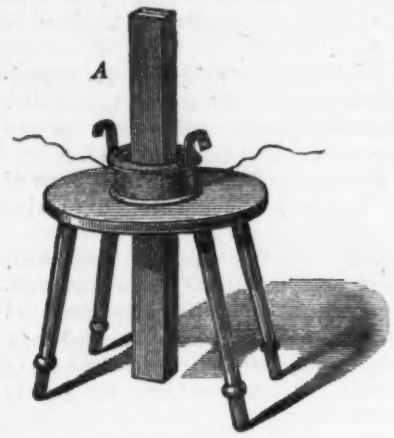


Fig. 4.—Transmitter.

"The ease and certainty with which the direction of the current and the movement of the needle dependent thereon can be governed

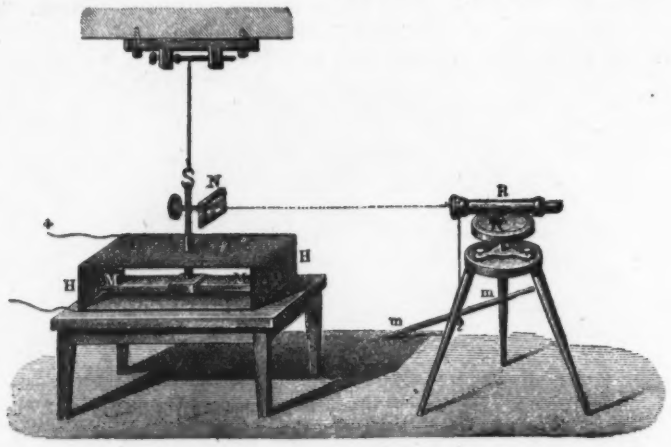


Fig. 5.—Receiver.

by the commutator, made possible the reliable and comparatively rapid transmission of intelligence and led, a year ago, to attempts to apply it to telegraphic signaling, which succeeded completely with entire words and small phrases. There is no doubt that in a similar way it would be possible to establish direct telegraphic connection between two places situated a considerable number of miles apart."

(To be continued.)

Novel Telephone Service.

In Mexico private telephone lines are being run to haciendas that are 20, 30 and even 60 miles from the nearest village, so as to enable the owners to talk with their foremen and know what is going on without making a trip that requires a day's ride. In India lines are proposed to the tea plantations. Such a service gives the tea planter an immense advantage by placing him in instant communication with all his workmen, making his intelligence at once available, and reducing the risks that attend the isolation of the industry. At New Haven, Conn., arrangements are being perfected by which the tobacco districts in the vicinity are to be telephoned a warning of approaching weather conditions which are likely to affect injuriously the tobacco crop. Some protection to the tobacco plants could be given by such warnings.

[18] "Poeg. Ann.," Vol. XXXII., p. 568; "Dingler's Journal," Vol. LV., p. 394; "Goettinger Gelehrte Anzeigen," 1834, 128th article."

Economic Size of Feed Wires for Electric Railways.

BY W. F. C. HASSON.

In a late investigation of an extensive electric railway system, it was found necessary to rearrange the entire system of feeders. The results obtained by applying the various formulas were both unsatisfactory and perplexing. A study of the question led to the following investigation, and the result obtained is not only believed to be sufficiently correct, but is certainly simple, and easily applied to any particular case.

In determining the economic size of feeders, a great variety of factors are involved, many of which are unimportant, and an attempt to consider all of them leads to complications that render the results practically useless. Certain things, such as station E. M. F., the constant for resistance for overhead and return conductors, and the ratio of interest and maintenance of feed wires to cost of fuel for power, must be considered fixed for any particular locality.

The existence of a station properly equipped and a trolley and return line properly constructed, must be assumed, and the question becomes to determine the point at which the difference in value of fuel saved and maintenance and interest of copper becomes a maximum. There is a limitation to the solution, in that the operation of railway motors is seriously affected if the E. M. F. varies considerably from that for which the motor was designed.

An investigation of roads that extend some distance into sparsely settled suburbs will show that in many cases the drop in E. M. F. at the end of the line is so great that the speed is reduced at the very point where high speed is both possible and desirable. With this in view, in the following investigation the drop in E. M. F. is made the variable by which this economic relation between interest on investment and value of fuel saved is determined.

Case I. Existing conditions of operation.

E = E. M. F. at station.
C_1 = current delivered.
$C_1 E$ = watts generated.
R = constant for overhead and return resistance for good construction.
D = distance to point under consideration.
v_1 = volts lost in transmission to point under consideration.
$W_1 = C_1 (E - v_1)$ = watts delivered at point under consideration.
S_1 = circular mils in feeders.
$W t_1$ = weight of copper in feeders.
c = cost of fuel per watt per diem.
F_1 = total cost of fuel per diem.
i = interest and maintenance per pound of copper per diem.
I_1 = total interest and maintenance of copper in feeders, per diem.

Then

$$(1) \qquad S_1 = \frac{D\, C_1\, R}{v_1},$$

$$(2) \qquad W t_1 = \frac{S_1}{334} \cdot \frac{D}{1000} = \frac{D\, C_1\, R}{334000\, v_1},$$

$$(3) \qquad F_1 = C_1\, E\, c,$$

$$(4) \qquad I_1 = \frac{D^2\, C_1\, R\, i}{334000\, v_1}.$$

Case II. Assumed conditions to give maximum economy.

C_2 = current delivered
$C_2 E$ = watts generated.
v = volts lost in transmission to point under consideration.
$W_2 = C_2 (E - v)$ = watts delivered.
S_2 = circular mils in feeders.
$W t_2$ = weight of copper in feeders.
F_2 = total cost of fuel per diem.
I_2 = total interest and maintenance of copper in feeders per diem.

Other quantities as in Case I. Then

$$(5) \qquad S_2 = \frac{D\, C_2\, R}{v},$$

$$(6) \qquad W t_2 = \frac{S_2}{334} \cdot \frac{D}{1000} = \frac{D\, C_2\, R}{334000\, v},$$

$$(7) \qquad F_2 = C_2\, E\, c,$$

$$(8) \qquad I_2 = \frac{D^2\, C_2\, R\, i}{334000\, v}.$$

Assuming power delivered in each case to be the same,

$$W_1 = W_2 \text{ or } C_1 (E - v_1) = C_2 (E - v),$$

and

$$(9) \qquad C_2 = C_1 \frac{(E - v_1)}{E - v}.$$

$$\text{Value of fuel saved} = F_1 - F_2 = F = E C_1 c \left\{ \frac{v_1 - v}{E - v} \right\}.$$

$$\text{Additional interest on copper} = I_2 - I_1 = I.$$

$$(10) \qquad I = \left\{ \frac{D^2 C_2 R}{334000\, v} - \frac{D^2 C_1 R}{334000\, v_1} \right\} i = \frac{D^2 C_1 R i}{334000} \left\{ \frac{E - v_1}{v (E - v)} - \frac{I}{v_1} \right\}.$$

To determine the value of v that will make $(F - I)$ a maximum.

For convenience place $N = \frac{D^2 R i}{334000}$ = a constant in any particular case.

Then

$$(11) \qquad F - I = C_1 \left\{ Ec \frac{(v_1 - v)}{E - v} - N \left(\frac{E - v_1}{Ev - v^2} - \frac{I}{V_1} \right) \right\}.$$

The first derivative becomes,

$$(12) \qquad C_1 \left\{ Ec \frac{(v - E + v_1 - v)}{(E - v)^2} + \frac{N (E - v_1)(E - 2v)}{v^2 (E - v)^2} \right\} = 0,$$

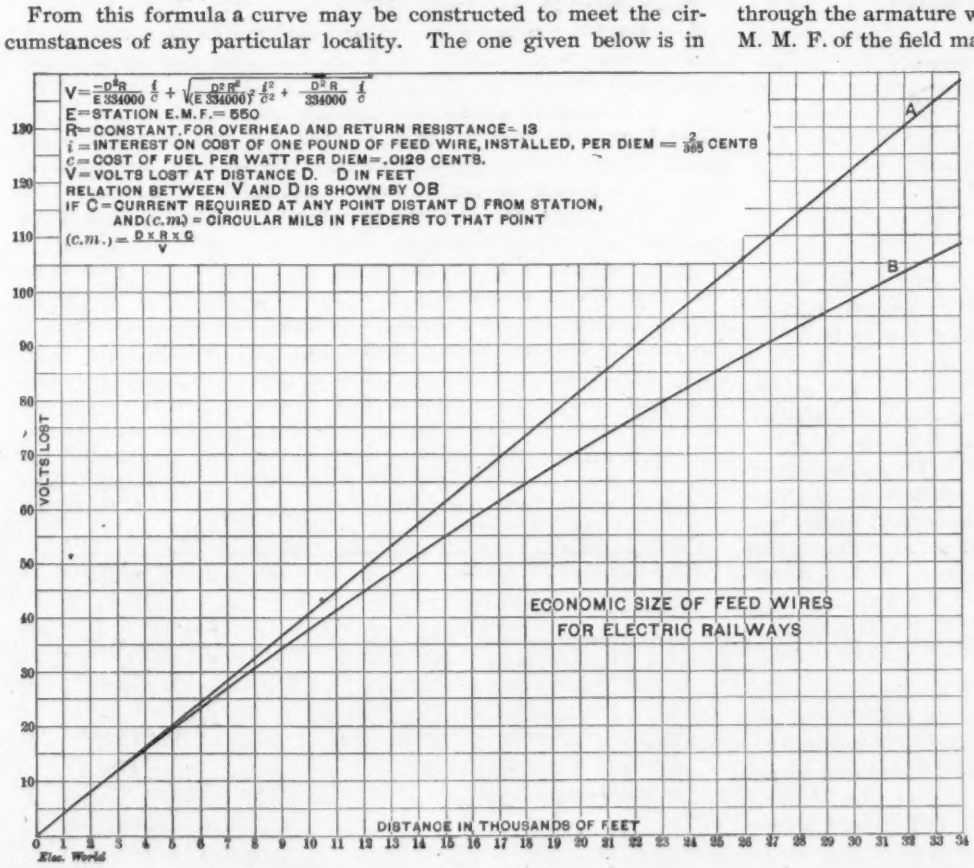
$$(13) \qquad Ec(v_1 - E) + \frac{N(E - v_1)(E - 2v)}{v^2} = 0,$$

$$(14) \qquad v^2 + 2 \frac{Nv}{Ec} = \frac{N}{C},$$

$$(15) \qquad v = -\frac{N}{Ec} \pm \sqrt{\frac{N^2}{E^2 c^2} + \frac{N}{C}}$$

$$(16) \qquad v = \frac{-D^2 R}{334000\, E} \cdot \frac{i}{c} + \sqrt{\left(\frac{D^2 R}{334000\, E} \cdot \frac{i}{c} \right)^2 + \frac{D^2 R}{334000} \cdot \frac{i}{c}}.$$

From this formula a curve may be constructed to meet the circumstances of any particular locality. The one given below is in accordance with the conditions found to be existing at Los Angeles. A study of the curve shows that a theoretical economy will be obtained by the loss of 100 volts when the distance becomes 30,600 feet from the station. It is evident that a limit to the desirable loss must be decided upon, and when that point is reached, the comparative cost of interest on copper, and expense for fuel, no longer becomes the important question in deciding the size of feeders. A limit to the drop in the E. M. F. having been decided upon, the size of feeders is calculated according to the ordinary formula. The curve then becomes useful only as a check to determine the departure from the theoretical economic size of feeders. It will be noted from the curve given that to a distance of 20,000 feet, at least, the size of feeders should be determined on the basis of economy alone.


V = -D²R/E 334000 · i/c + √((D²R²/(E 334000)²) i²/c² + D²R/334000 · i/c
E = STATION E.M.F. = 550
R = CONSTANT, FOR OVERHEAD AND RETURN RESISTANCE = 13
i = INTEREST ON COST OF ONE POUND OF FEED WIRE, INSTALLED, PER DIEM = 2/365 CENTS
c = COST OF FUEL PER WATT PER DIEM = .0126 CENTS.
V = VOLTS LOST AT DISTANCE D. D IN FEET
RELATION BETWEEN V AND D IS SHOWN BY OB
IF C = CURRENT REQUIRED AT ANY POINT DISTANT D FROM STATION,
AND (c.m.) = CIRCULAR MILS IN FEEDERS TO THAT POINT
(c.m.) = D × R × C / V
A
B
VOLTS LOST
ECONOMIC SIZE OF FEED WIRES
FOR ELECTRIC RAILWAYS
DISTANCE IN THOUSANDS OF FEET
Elec. World

CURVE FOR DETERMINING ECONOMIC SIZE OF FEEDERS.

It is further evident that when the distance becomes greatly in excess of 20,000 feet, the best results will probably be obtained by using a higher E. M. F. force at the station, and employing boosters for the distant part of the lines. For short distances the first part of the formula may be neglected, and the equation becomes

$$v = D \sqrt{\frac{R}{334000} \cdot \frac{i}{c}}.$$

This is represented by the line $O A$, and it will be noted that at a distance of 10,000 feet there is only a difference of three volts between the result obtained from the curve and from the straight line. It may be claimed that the question of interest on station machinery should be taken into consideration. It is highly probable, however, that the capacity of station machinery would not be affected. There would be a further gain by the saving of power that would be lost in feeders, and using it for the operation of motors. This, however, follows as a natural result from the economic relation between the interest on copper and cost of fuel, and should not be taken into consideration in determining the economic drop in E. M. F.

Electrodynamic Machinery—XLVI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

339. As already mentioned, the condition of constant torque and variable speed is one which it is much more difficult for the electric motor to meet. If it were possible to vary the useful magnetic flux through the armature within wide limits, the method of varying the M. M. F. of the field magnets would effect the result desired. While, however, it is possible to produce a variation of speed in the ratio of three to one, by varying the M. M. F., that is to say, while motors have been constructed, under special conditions, which will run, say at from a maximum of 900 to a minimum of 300 revolutions per minute, merely owing to variation in the M. M. F. of their fields, yet such a range is only obtained with great difficulty, owing to the fact that magnetic saturation is reached at maximum M. M. Fs. in the iron constituting the magnetic circuit, and that when the field flux is greatly reduced, the armature reaction at full load is liable to be excessive, with heavy sparking at the commutator. The maximum range of speed in an ordinary shunt motor, brought about by field regulation, is only about 25 per cent., so that a motor whose maximum safe speed is 1,000 revolutions per minute, can be reduced to a minimum of about 750 revolutions.

340. The M. M. F. of a motor field may be varied electrically in two ways; namely, by altering the current strength through the field coils as a whole, by the insertion, for example, of a varied resistance in their circuit; and second, by altering the action of certain portions of the field coils relatively to other portions, as, for example, by changing them from series to parallel, or the reverse. In shunt-wound motors, the regulation is usually effected by the introduction of a field rheostat. In series-wound motors it is usually effected by varying the number or arrangement of the field coils. Thus the arrangement for connecting the field coils of a particular form of street-car motor is represented in Fig. 211. It will be seen that there are three coils on each limb of the field, but each pair is permanently connected as shown, so that electrically there are only three coils, A, B and C. By the action of the controlling switch, these coils may be connected as shown in the diagram.

In Position 1, all three coils are in series, making the relative M. M. F. 3 and the relative resistance 3.

In Position 2, one coil is short circuited, making the relative M. M. F. 2 and the relative resistance 2.

In Position 3, two coils are connected in parallel, making the relative M. M. F. 2 and the relative resistance 1.5.

In Position 4, two coils only are connected in parallel, making the relative M. M. F. 1 and the relative resistance 0.5.

In Position 5, all three coils are connected in parallel, making the relative M. M. F. 1 and the resistance 0.333.

Fig. 212 represents the characteristic curve of a particular motor of this character, with the flux in megawebers, passing through the armature with different excitations of the field magnets, expressed in ampere-turns. With the aid of this curve it is possible to estimate the range of speed which can be obtained by connecting the coils in different arrangements. For example, at half load of 7½ HP, or say 5,600 watts output, and an efficiency of say 0.8, the activity absorbed would be 7,000 watts, or 14 amperes at 500 volts pressure. There are, approximately, 2,100 turns in the field coils, or 700 to each pair, so that with all in series, the total M. M. F. would be $14 \times 2{,}100 = 29{,}400$, which might produce a flux of 2.9 megawebers through the armature. With all the coils in parallel, the M. M. F. would be three times less or 9,800, and the flux 2.12 megawebers. The ratio of speed, therefore, would be $\frac{2.9}{2.12} = 1.368$, so far as regards the effect of change in magnetic flux through the armature. In practice the speed would vary in a somewhat greater ratio, owing to the influence of greater drop in the field magnets when connected in series than when connected in parallel. We may consider, therefore, that at light loads the influence on the speed of varying the field coil connections is considerable, but at heavy loads the influence is small.

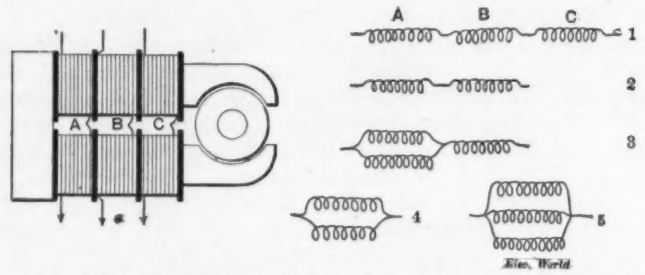


Fig. 211.—Diagram Showing One Method of Series-Parallel Field Excitation in a Street-Car Motor.

341. We have seen how the speed of a motor can be controlled within certain limits by varying the magnetic flux usefully passing through its armature. The same results can be effected by introducing resistance into the armature circuit.

342. If the constant torque imposed upon the motor is such as requires a current of I amperes to pass through its armature, while a given constant magnetic flux is produced by the field, and if E, be the pressure in volts across the main leads, and r, the resistance of the armature in ohms, the drop in the armature will be Ir volts, and the armature of the motor must develop that speed which will produce a C. E. M. F. of $E - Ir$ volts. If it be required to reduce this speed to say, one half, then the total resistance of the armature circuit must be increased to R ohms, in such a manner that $E - IR = \frac{E - Ir}{2}$, so that $R = \frac{E + Ir}{2I}$. While this plan is theoretically effective, it is practically objectionable, because, in the first place, it wastes energy by the introduction of the additional resistance $(R - r)$ ohms, the amount of activity wastefully expended in such resistance being $I^2 (R - r)$ watts. In the second place, a comparatively small accidental variation in the torque, which we have hitherto supposed constant, would effect a large variation in the speed, owing to the varying drop in the added resistance. Again, a powerful motor requires a powerful current strength to be supplied to it, and a large expenditure of energy is necessary in order to greatly reduce its speed in this manner, requiring the use of bulky and expensive resistance, to disengage the heat developed. For these reasons this method of maintaining the speed constant is seldom employed.

343. It has been found so difficult in practice to vary the speed of a motor at constant torque between full speed and rest, without loss of efficiency, that in cases where complete control is imperative, as in some rolling mills, where the machinery has to run occasionally at a definite very low speed, and at other times at full speed, a method, which is represented in Fig. 213, has been invented and applied. Here M, is a shunt-wound motor, connected across a pair of supply mains, AA, BB, and, therefore, running at practically constant speed under all conditions of use. The armature of this motor is connected directly, either by a belt or by a rigid coupling, to the armature of the generator G, whose field magnets are excited through a rheostat R. The generator armature consequently runs

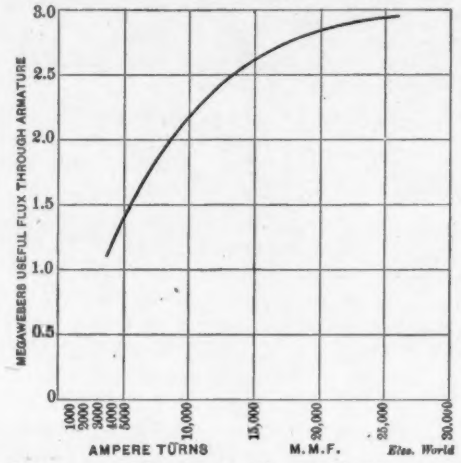


Fig. 212.—Curve of Magnetic Flux Through Armature in Relation to M. M. F. of Field Magnets.

at a practically constant speed under all conditions of service. The E. M. F., which this generator armature develops, depends, however, upon the excitation of its field magnets, which is regulated by the rheostat R, so that, when no current passes through the generator field coils, the E. M. F. of its armature is nearly zero, while, when full current strength passes through the field coils, the E. M. F. of the generator is at its maximum. The brushes of the generator are directly connected with the brushes of the working motor m, whose field magnet is constantly excited, and the speed of the armature m, will be controlled directly by the E. M. F. of the generator G. If the generator is fully excited, the E. M. F. at the terminals of the motor m, will be a maximum, and the speed of the motor to meet this E. M. F. with a corresponding C. E. M. F. will also be a maximum, while if the generator has its excitation removed, the armature of the motor m will almost come to a standstill. If necessary, the connecting wires between the armatures of G and m, can then be reversed so that the direction of m's rotation can be reversed.

344. The fact that this combination of machines operates satisfactorily without excessive sparking at the commutator of the generator, often occasions some surprise to those who are accustomed to varying the field excitation of generators and motors, under ordinary conditions, since it is known that, in general, when a generator, and particularly a motor, has its field magnets considerably weakened, a violent sparking is apt to be produced at the commutator. It is to be remembered, however, in this case, that the armature of the weakened generator G, is never permitted to send more than the full-load current strength, which is required to overcome

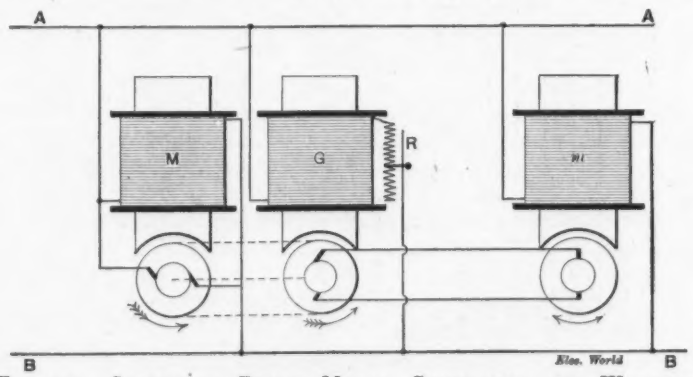


Fig. 213.—System of Prime Motor, Generator and Working Motor for Controlling the Speed and Direction of the Working Motor Under Constant Torque.

the full-load torque, while, on the contrary, if this machine were employed across constant-potential mains as a motor and a magnetic flux through the armature were considerably weakened, the current strength which would pass through the armature would be, probably, much in excess of the full-load current, with a cor-

responding tendency to produce excessive armature reaction and sparking.

345. Although the preceding combination of apparatus effects the desired result of varying the speed of a motor at will under constant or even under variable torque, within the limits of full load, yet it has the double disadvantage of requiring the installation of three times the amount of machinery which would otherwise be necessary, and of having a considerably reduced efficiency of operation. If, for example, the motor M, has to be a 10-KW machine, then the generator G must at least have a capacity of 10 KW, and at least an equal capacity will have to be given to the prime motor M; so that 30 KW of machinery are installed, where 10 are directly employed. Again, if the commercial efficiency of each machine were 83 per cent. at full load, the commercial efficiency of the combination, under full load, would be approximately $0.83 \times 0.83 \times 0.83 = 0.572$, so that the combination would have a full-load efficiency of 57.2 per cent. At light loads the combination efficiency would be still lower; for example, if at half load the efficiency of each machine were 75 per cent., the combination efficiency would be 42.2 per cent. On the other hand, however, the introduction of resistance into the armature circuit of a motor, in order to reduce its speed, would probably effect as low or even a lower efficiency. It is evident, therefore, that in this direction the electrical motor shows its weakest side.

346. The fourth condition of working; namely, under variable torque and variable speed, differs from the last only in the variability of the torque. This being, as we have seen, the condition of working with street-car motors, it is probably one of the most important conditions to be met. It is met within the limits of practical requirements in street-car motors, partly by controlling the field magnets, and partly by the introduction of resistance into the armature circuits, through the series windings of the field coils, or by the direct insertion of external resistance. The problem, however, of controlling within full range the speed of a single continuous-current motor, under varying torque, with high efficiency, is, strictly speaking, yet unsolved.

347. In some cases two motors are rigidly coupled together so that they may have their armatures connected in series or in parallel. In the first case they divide the pressure of the C. E. M. F. between them, so that their speed will be a minimum under that condition. In the second case they each take the full pressure, and so yield the maximum speed. At slow speed, however, when connected in series, it is evident that the activity of the combination will be $E\,I$ watts, since each machine can now take I amperes. At full speed, since each armature can take I amperes, the available activity will be $2\,E\,I$ watts. The combined torque, for the full-load current through each armature, will be the same whether they are in parallel or in series.

348. If a series motor be at rest, and be connected directly across the mains, then if the resistance of the armature and magnet coils together be R ohms, the current strength passing through the motor tends to become $\frac{E}{R}$ amperes, E, being the E. M. F. at the supply mains. Thus, if a 1-HP series-wound motor has a resistance in the

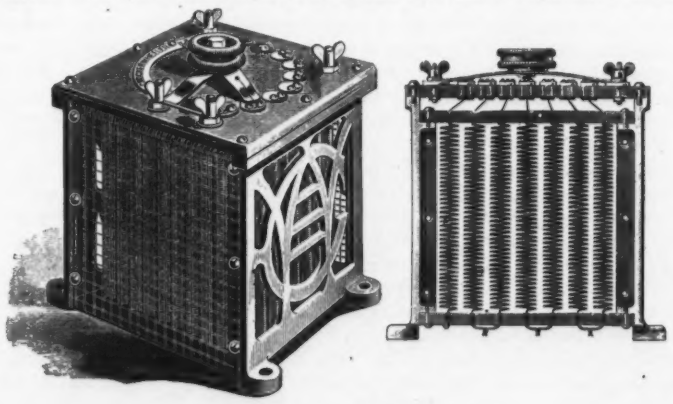


FIG. 214.—STARTING RHEOSTAT.

armature of 0.5 ohm, and a resistance in the field coil of 0.5 ohm, the total resistance in the machine will be 1 ohm, so that the first tendency is to produce a current strength of $\frac{110}{1} = 110$ amperes, as soon as the machine is connected with the circuit, assuming the mains to have a constant pressure of 110 volts, whereas the full-load current strength of the machine will be about 10 amperes. As soon as the armature has become able to develop its full speed, the motor will generate such a C. E. M. F. as will limit the current through it to that required to expend the energy it wastes and delivers. The rapidity with which the armature will reach its full speed depends upon the load connected with it, upon the inertia of the armature and of its load, as well as upon the current strength entering the armature. Moreover, owing to the self-induction or *inductance* of the field magnet coils, it is impossible to develop the full current strength immediately in them, even assuming that the

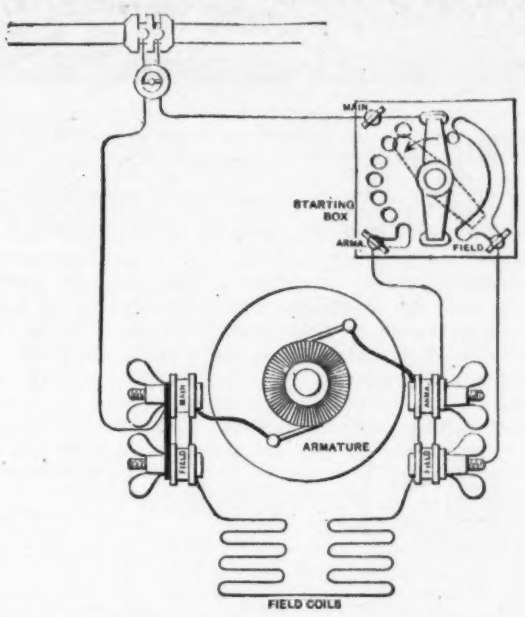


FIG. 215.—CONNECTIONS OF STARTING RHEOSTAT WITH SHUNT MOTOR.

armature were to remain at rest. As soon as the current excites the field magnets, the flux they produce, passing through the magnetic circuit, develops in the field coils a temporary C. E. M. F., which has a powerful influence in checking the first inrush of current into the armature during the first half second or second of time. For this reason, a series-wound machine is much more safely started from rest to full speed than a shunt-wound machine, in which the armature has to be connected across the mains.

349. In all except the smallest machines of the shunt-wound type, it is necessary to insert some resistance in the armature circuit when starting from a state of rest, so that the drop produced in such resistance by the starting current may limit the amount of current passing through the armature. For this purpose special rheostats, called *starting rheostats*, are inserted in the armature circuit. Since they are only intended to carry the current during the time that the motor is coming up to speed, they are not usually devised to carry the full current strength of the motor indefinitely, and, therefore, a starting rheostat should never be maintained constantly in circuit. Fig. 214 represents a form of starting rheostat employed with shunt-wound motors. Here a number of coils or spirals of galvanized iron wire are mounted in a fire-proof frame under a cover of slate or composition, on which a number of contacts are arranged in a circle. Fig. 215 represents the manner in which such a rheostat is connected in the armature circuit.

(To be continued.)

Laboratory of Houston and Kennelly, Philadelphia.

An Electrical Phenomenon.

An Albany, N. Y., newspaper relates that recently during a thunder storm, the electric fluid ran down the point of an umbrella, and so paralyzed the arm of a young man that it remained clasped around the waist of a young lady he was walking with, and she was extricated with the greatest difficulty. It was also noticeable that the same stroke seemed to have affected her will power, and she was incapable of rendering any assistance to those who were trying to rescue her from the young man's fierce and unconscious embrace. Hereafter, the writer concludes, when a stray arm is seen around a girl's waist during a thunderstorm it can be explained as a purely electrical phenomenon.

Electric Traction in Austria and Hungary.

It is proposed to convert the Schwabenberg Mountain Rack Railway into an electric line, and to extend it from Budapest as far as Anwinkel. Plans have been prepared for a local electric railway between Budapest, Foch, Wartzer and Hartyan.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE BY CARL HERING

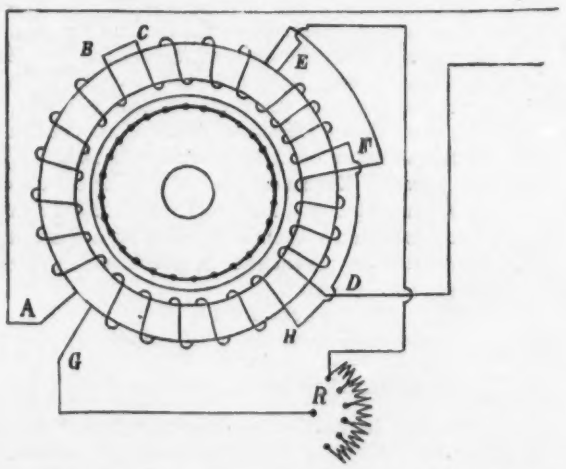
COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—Typewritten copies of any of the articles referred to in the Digest will be furnished at the rate of 5 cents per 100 words for English matter, and 8 cents per 100 words for matter in foreign languages; translations at the rate of 40 cents per 100 words. Copies of any of the journals may be ordered; address Branch Office, ELECTRICAL WORLD, No. 927 Chestnut Street, Philadelphia, Pa.

DYNAMOS, MOTORS AND TRANSFORMERS.

Armature Reaction in Multiphase Dynamos.—The "Elek. Zeit.," Aug. 8, contains a short article on this subject by Mr. Korda. In the ordinary alternators, excited with continuous current, the currents in the armature act inductively on those in the field, producing undulations in the field; such perturbations do not take place in multiphase generators; he shows that the conditions are such that the inductive actions, which for constant armature currents is caused only by the motion, are continually balanced by that which corresponds to the change of the current strength; it is assumed in this that all the branches are equally loaded and that the currents follow the sine law. It follows from this that multiphase generators could be made self-exciting by the use of a small commutator for collecting the exciting current, and that for every load a sparkless position can be found for the brushes; the same is true of such machines when used as synchronous motors, for while they are started an exciting current is not necessary but on the contrary would act unfavorably. That the sparkless position of the brushes is determined like in continuous-current machines, he proved with a small 6-hp three-phase motor using a frequency of 25; a continuous-current machine was so changed that both the commutator and three collector rings for the three-phase currents could be used, the commuted currents being used for excitation; for all loads this machine operated without sparking. He discusses the subject analytically for two-phase machines as the results are the same for any number of phases; he shows that the total perturbation is zero independently of the speed or the load.

Polyphase Motor Run by Monophase Currents.—In "L'Elettricista" for June Mr. Bonfiglietti suggests the following method for obtaining a rotary field by a simple alternating current without the use of separate transformers, self-inductions or shunted currents. Referring to the accompanying figure, two coils *A B* and *C D* are wound on a laminated iron core and are connected in series to the source of the current; two other coils *E F*, and *G H*, are wound on the same core and are closed on a regulating resistance *R*; the current circulating in the first circuit will induce in the coil *E F* a current displaced in phase by $90° + \phi$, in which ϕ may be made equal to 30° by properly adjusting the resistance *R*. He believes that the combined action of these currents would give rise to a rotary field in the space enclosed by the ring, where a suitable armature could be placed, thus forming a rotary field motor.



Regulating Dynamos Driven by Steam Engines.—In a recent paper by Mr. Melotte, abstracted in "L'Eclairage Elec.," Aug. 3, he shows that in order to increase the voltage of a shunt dynamo, driven by an engine with fixed expansion, it is necessary in certain cases to diminish instead of increase the excitation. If at a little less than full load the speed is such that the voltage is too low and if one then attempts to increase the voltage by increasing the excitation then the load on the engine increases, which decreases the speed, but the power of the dynamo increases more rapidly than the speed, while that of the engine diminishes proportionately to this velocity, so that a state of equilibrium is reached at a lower speed than the previous one; if, on the contrary, one diminishes the excitation, the load will be lessened, the engine will increase in speed, generating a proportionately greater power; but with that speed the load of the dynamo increases faster than that of the engine, so that a new state of equilibrium will be reached at a greater velocity and voltage. This method of regulating is no longer effective when a speed is reached at which the regulator begins to act to prevent the increase of speed. In an actual case he increased the voltage from 115 to 125, and the speed from 315 to 350, at the full load, by diminishing the excitation; the same peculiarity was noticed in regulating a dynamo driven by a gas engine.

A Theory of the Synchronous Motor.—The recent paper of Mr. Rhodes is published in the Lond. "Proc. Phys. Soc." for August.

Tests of a Polyphase Motor.—The "Elec. Jour." (Chicago), Aug. 15, contains an article by Prof. Jackson, in which he gives the results of tests in the form of curves, made with a three-phase motor of three to five hp built by the General Electric Company of Berlin. The current was supplied from a rotary transformer at varying frequencies between 53 and 60; the efficiencies over the whole range of frequencies are very good and compares favorably with those of a continuous-current motor; the drop in speed was about 7.5 per cent. at the best frequency; from curves showing the relation of the power factor to the frequency at different loads it appears that the highest power factor is slightly more than 80 per cent. and that this motor must therefore use upward of 20 per cent. more current than is represented by its output.

Improvements in Armature Ventilation.—The "Sibley Jour." for April publishes an article by Prof. Ryan containing some useful data and deductions. The ventilation of an ordinary cylindrical armature such as was in common use for two-pole generators is 0.034 watts per square inch of surface per degree Centigrade rise of temperature above the surrounding atmosphere, the peripheral velocity being 3,000 feet per minute; he evolves some formulas from which he finds that for a fixed allowable rise of temperature the square of the current output will vary as the depth of the copper and from this he determines the following values: for the following numbers of amperes per inch width of conductor 750, 900, 1,250 and 1,750; the circular mils per ampere are 420, 510, 710 and 970 and the depth of conductor in inches 0.25, 0.36, 0.69, and 1.36. He deduces another equation from which he determines the rate at which the temperature due to the copper resistance, increases with respect to the current for different current densities and a rise of 55° C.; for the same circular mils per ampere and depth of copper as in the above, these rates are 0.146, 0.122, 0.088 and 0.063; in practice it is desirable to adopt a current density that will give low figures for the depth of copper and for the rate, but as the one goes down while the other goes up, probably the best current density is not far from 500 circular mils which occurs at a depth of copper of 0.35 inches for a rise of 55° C. due to resistance losses; he verifies these figures by giving a table for the standard Edison 110-volt generator. Unless a radical change in design is made in such armatures one will be very much hampered by this type of construction; the depth of copper cannot with economy be made more than 0.35 inches unless the allowable rise of temperature is lowered; one is practically limited to one depth of copper for all sizes, leaving little choice as to copper and iron proportions. This emphasized the great need of improved facilities for armature ventilations, and such improvement has been steady since 1890; there has been a great development of the multipolar types with short, hollow armatures of large diameters which are much better ventilated, and in addition to this, ventilating flues are provided by means of which ventilation has been increased very materially, increasing the radiation coefficient from 0.034 to 0.04, and probably 0.06 in some cases, thus enabling the makers to deliver machines for lower temperature rises which will stand 10 to 20 per cent. continued overload. The sparking limit may now be entirely removed by a commutation lug and pole-face coils for balancing the armature reaction and regulating the induction at the commutation lug so as to be proportional to the output, as described in an Institute paper read in March, 1895; to take full advantage of this it is necessary to improve the armature ventilation to the greatest available extent without sacrifice, which is done by Mr. Thompson's device, in which it has been found that the ventilation is proportional to the depth of the copper, enabling the maker to select exactly those proportions of iron, copper, working induction and current density that will give the best efficiency and durability at the lowest cost.

Compounding Dynamos for Armature Reaction with Converters.—The "West. Elec.," Aug. 31, contains an interview with Dr. W. P. Freeman regarding his prior invention of the converter system; a brief description with some sketches is given; it appears that he began in 1881, and that in 1888 he obtained a patent which does not, so far as he can see, enable a multipolar field machine to be used when only one half of the pole-pieces are wound, without infringing.

Thirty-Thousand-Volt Transformer.—The "Sibley Jour." for June contains a short description by Mr. Plumb of a 7-kw, 140 to 30,000-volt transformer recently constructed at the college shops for determining insulation properties. Paraffin oil, in which the transformer is immersed, is relied upon almost entirely for the insulation; the insulation is calculated for 50,000 volts, but the highest yet attained was 43,000, sparking across a gap 4.063 inches; the magnetic circuit, of rectangular form, is made of two parallel iron cylinders, 5 inches in diameter and joined at the ends; the primary is applied, one half on each core, and the secondary is mounted on 30 wooden spools, ⅛ in. apart, 15 on each core, leaving a space of 0.75 inches between the two circuits; the principal dimensions are given. He gives the results of tests of the oil used, showing the gap through which the discharge took place and the voltage.

Oil Gap.	E. M. F.	Air Gap.
.01	400	....
.03	2,140	.03
.05	5,190	.105
.075	6,280	.135
.1	6,980	.155
.15	11,200	.285
.2	13,330	.385

The following results are also of interest: Mica, 0.0103 inches thick was punctured at 16,900 volts; 0.079-inch glass at 20,300; 0.01305-inch red fibre at 7,400; 0.0184-inch of four layers of oil paper at 10,400; 0.0108-inch hard rubber did not break down at 20,500; 0.156 inches of porcelain did not break down at 22,000; a 500-volt circuit glass insulator did not break down at 30,000, and with one terminal in the inside and the other over the top, it withstood 43,000 volts. The system of regulation is described and the results given; it is thought that the transformer will regulate from no load to full load with less than a 10 per cent. drop.

Alternating Currents.—"Elec. Power" for September reprints a long paper of a popular nature, by Dr. Bell, recently read at the Cooper Union, which is largely devoted to the history of alternating-current machinery.

LIGHTS AND LIGHTING.

Mercury Arc Lamp.—In the "Zeit. f. Beleucht.," Aug. 15, Dr. Arons gives an illustrated description of his curious arc lamp, a full description of which was given in the Digest, Feb. 11, 1893; it has come into use in a large number of institutions, especially for research work. It consists essentially of an inverted U-shaped tube the legs of which are nearly filled with mercury with which electrical connection is made by means of platinum wires fused through the glass; the bent portion of the tube, which forms the top, contains no mercury; the tube is exhausted as perfectly as possible as the action will be more satisfactory the more perfect the vacuum; about 60 volts are required; to start the arc the tube is shaken or tilted sufficiently to make contact between the columns of mercury, an adjustable resistance being placed in series with it; the voltage at the electrodes for currents from two to 15 amperes is from 15 to 18 volts; the counter E. M. F. is said to be about 12 volts; for every centimetre of length of arc irrespective of the current, 0.7 volts are required. The tube is filled with a very bright, greenish white light which is very steady and uniform; the discharge is said to be discontinuous and it is thought that a much higher voltage is required than appears by measurement at the electrodes; with an alternating current of even as high as 175 volts at 8 amperes when started, the lamp cannot be made to burn; several lamps may be connected in series; the light does not show a continuous spectrum but gives the line spectrum of mercury; it is specially applicable for optical measurements for which an intense light of a definite wave length is required; with four and five amperes the lamp can be burned for hours without fear that the tube will be destroyed; the mercury distills over from the hotter anode to the cooler cathode; but little mercury is deposited on the glass near the anode and it is here where the light is best adapted for optical experiments; for stronger currents the lamp should be placed in a bath of water. Prof. Lummer, of the Reichsanstalt, who uses this form of lamp largely, makes it of a horizontal glass tube having two vertical branches fused to it near the middle for containing the mercury; the ends of the long horizontal tube will then be free from deposits of mercury; an illustration is given. Researches with amalgam, alloys of sodium and potassium, and Wood's metal, have so far given no good results. In order to make the vacuum more perfect the lamp is started while the tube is still connected with the pump.

Phase Shifting in the Alternating Arc.—"L'Ind. Elec.," Aug. 10, contains an article by Prof. Blondel, in which he refers to his former published statements and describes some new and interesting results which seem to contradict the generally accepted conclusions. In his previous statements he said that in the arc there was neither polarization nor E. M. F. in the ordinary sense, at least their values were inappreciable. In his recent experiments he finds that under certain circumstances there is an appreciable shifting in phase which, however, is scarcely appreciable in the value of the power factor; this shifting is not produced with soft-cored carbon nor was it obtained ordinarily with homogeneous carbons, but it was, in general, with hissing arcs whose curves have special forms characterized by a prolonged cessation of the current; he noticed it in "screeching" arcs between poorly conducting cored carbons and in which the current had a small value during the extinction of the arc; the current and voltage curves of such an arc are given; while the voltage falls rapidly from positive to negative the current is small, and ordinarily the two curves intersect the axis in common, showing that there is no shifting; in the new phenomena observed, the current curve near this point appears to be shifted vertically so that the two curves no longer intersect at the same point; a pair of such curves taken by means of his photographic stroboscopic method are given; the displacement shows a retarding of the current with regard to the voltage, but if the sudden bend of the curve at this point be smoothed off this retardation disappears. He discusses the possible explanation; the curve is behind the E. M. F., and it therefore cannot be explained by a counter E. M. F.; he suggests a thermoelectric E. M. F. between the arc and the positive carbon; also a certain inertia of the material transported; in the latter case deviations ought to be greater with increasing frequency (he used a frequency of 50 in his experiments). In conclusion he calls attention to the importance of experimenters specifying what carbons were used in their experiments, as the part played by the carbons is very great, the voltage in some cases varying as much as 10 and the curves changing their character completely; he believes that any possible similarity between the phenomena of the alternating arc and those in electrolysis, is merely hypothetical and is not justified. The simplest explanation of the alternating arc is that the principal phenomenon is a resistance at the surface of the positive carbon corresponding to the energy of volatalization, conforming with the theory which is accepted at present for the continuous-current arc.

Absorption of Light by Transparent and Translucent Globes.—In a short paper by Mr. Stort in the "Elek. Zeit.," Aug. 8, he shows that there often exists a false impression regarding the losses of light passing through such glasses, as it is generally assumed to be much higher than it really is; there is an optical deception, for instance, when there is a hole in the globe, the light passing through which appears to be much greater than that which surrounds the opening; the space illuminated by the light passing through the opening is also illuminated by the diffused light passing through the glass and it therefore receives two superposed illuminations. The losses are often supposed to be 30 to 50 per cent., but as ground globes are nothing more than an aggregation of lenses and prisms, the reason for such a large loss cannot be easily explained; the error made by many lies in the way in which this loss is calculated; if the intensity is layed off as a polar diagram, as usual, and if one wants to determine the mean intensity, it is not correct to take the mean polar co-ordinate as representing the mean spherical intensity; the light zones are greatest near the horizontal directions and diminish with the sine of the angle of depression; the correct construction is obtained if the rays are projected on the horizontal diameter and these projections be made abscissas, the intensities of the light being made the ordinates, the area of the curve will then be the total intensity. He gives the results of some recent experiments in which the errors made in a previous determination were corrected; results are given in curves and tables, the final conclusions being as follows, for the naked light, a clear globe and a translucent globe ("Ueberfangglas") respectively: For the maximum intensity 1,161, 1,165.5 and 653.5; for the mean spherical intensity below the horizon 635, 605.8 and 494; for the total mean spherical intensity 362, 363.1 and 320; the loss in per cent. being therefore 0, 6 and 11. The nature of the translucent glass will of course make a great difference, but the results show that no fear need be had regarding the great loss in globes, but that, on the contrary, by the proper application of such globes, the illumination is greatly improved. Experiments were made for continuous and alternating currents of various strengths, the results of all of which agreed very well with each other; the measurements were made in two directions diametrically opposite to each other, so as to eliminate an unsystematical position of the crater.

Exhausting Incandescent Lamp Bulbs.—The Malignani process is described in "L'Elettricista," Aug. 11, a brief abstract being given in Lond. "Elec. Eng.," Aug. 16; he obtained a gold medal for this at the recent Scientific Congress at Venice; it has been patented in all countries. He introduces in the exhaustion tube a small piece of a special chemical composition; the lamp is attached to the pump and after about 20 seconds a current is passed through the filament for 10 or 15 seconds after which the tube is closed, cutting off communication with the pump; the lamp is then relighted and the glass tube is heated with a gas jet at the place where the fragment of that chemical composition is placed; this produces vapors which "with the co-operation of the electricity" causes the vapors emanating from the filament to be precipitated as a solid and producing a perfect vacuum in the globe; the whole operation lasts about a minute and it is claimed that 45 lamps can be exhausted in an hour; the great advantage is in avoiding the use of mercury. The filaments of the Malignani lamps are made as follows: about 30 sheets of white paper, washed with acidulated water, are placed over one another and heated to 70 or 80 degrees, which transform them into a transparent, gelatinous mass which when cooled is subjected to a great pressure and forced out through a die into a mixture of water and nitric acid and after washing and drying, is carbonized. (See also Digest, March 2.)

Phenomena Observed with the Electric Arc.—A translation of the article by Mr. Nodon, abstracted in the Digest, July 27 and Aug. 10, is published in the Lond. "Elec. Rev.," Aug. 16.

The Study of Arc Lamps.—The "Year Book" of the Univ. of Minn., May, 1894, contains a short article by Prof. Shepardson in which he gives the results, in the form of curves, of a series of tests made at the Univ. of Minn. with differential and shunt lamps, the readings of the current and voltage being taken every five seconds. The curves show that with small currents the action of the differential lamp is much more irregular while with stronger currents and voltages the feeding is more uniform; with shunt lamps the voltage is much more uniform and such lamps are more independent of changes in the current strength than the differential lamp, from which it follows that if shunt lamps are used on series circuits close regulation of the dynamo is not so essential as with differential lamps. The curves show the intimate relationship between the current and the voltage when a lamp is in series with a dead resistance on constant voltage circuits; fluctuations are more violent on the differential than on the shunt lamps; he concludes that for a single lamp in a constant voltage circuit a shunt lamp would regulate more closely than a differential lamp.

Competitors of the Electric Light.—The "Year Book" of the Univ. of Minn., May, 1895, contains an interesting article by Prof. Shepardson in which he gives the history and present state of the art of lighting by other means than by electricity; it is rich in references to the original sources. It appears that the first case of public lighting of streets which was attempted was in 1770 in Paris, the lighting being done by means of oil lamps.

Incandescent Lamps in the United States.—According to the "Elec. Rev.," Aug. 28, there are now in operation in the United States more than 20 incandescent lamp manufacturing companies, whose daily output is estimated at 30,000 lamps.

Operation of Arc Lamps by Commutation of Two-phase Currents.—A thesis by Messrs. Barnes and Stilwell is published in the "Sibley Jour." for June. They state that "Its successful investigation shows that a suitable arc current may be taken from any multiphase alternator, which is equally available for incandescent lighting and the transmission of power, thus dispensing with the small machines which are lowering the efficiency of our larger plants from which much arc lighting is done." The "object sought was the production of constant current by the introduction of self-induction into each branch of the two-phase circuit." They show by means of a diagram that such self-induction tends to produce constant current; the currents after having passed through the induction coils were commutated to one direct current and used for arc lights; a single-phase current could have been used but would not have been as constant after commutation as the two-phase current.

Experimental Investigations with the Arc.—"Elec. Power" for September contains an article by Mr. Freedman, in which he explains several unsuccessful and one successful method for separating the measurements of the counter E. M. F. and the resistance of the arc, in order to determine the value of the former; the successful method was one suggested by Dr. Pupin and consists in measuring the resistance of the arc by placing it, while it is being run by a direct current, in one arm of a Wheatstone bridge in which a small alternating current circulates, having a value of about 1 per cent. of that of the direct current so that the current in the arc is practically a constant one; a telephone with a condenser is used in place of the galvanometer; the point of minimum sound indicates the balance of the bridge for the alternating circuit irrespective of what direct current flowed; the method is quite a tedious one. The average value of the resistance of the arc was found to be 0.677 ohm, the current being 10 amperes, the length of the arc 0.1 inch and the voltage at the terminals 42; from this it follows that the counter E. M. F. of that arc was 25.23 volts. (If that is correct, how is it possible that arc lamps can be run with short arcs at less than 35 volts?)

Electrically Lighted Buoys.—Mr. Henry in "Elec. Power" for September gives an illustrated description of the installation in the Gedney channel (New York) and the course on Lake Michigan from Chicago to the World's Fair; in the latter, incandescent lights with their transformers are placed at the ends of the buoys and are connected by a cable; at first an iron cable was used, but it was found that the retardation due to the armor was too great; the lamps and transformers were then replaced by Bernstein lamps. The difficulty of retardation is overcome in the Gedney plant (see Digest, Aug. 10), by using a non-magnetic armored wire consisting of hard drawn copper.

POWER AND HEAT.

Electricity in Mining Work.—A series of articles by Mr. Clarke is begun in the Lond. "Elec. Eng.," Aug. 16. It appears that he intends to cover the ground quite completely from a practical standpoint, including descriptions of the important installations, accompanied by tests, results, criticisms and comparisons with other systems of transmitting power. In the present portion he examines the general conditions which limit the use of electricity considering first the danger of exploding gases. It has been shown that excessive sparking will explode the gas in collieries; the brushes and commutator may be enclosed in a case which is either gas tight or has openings covered with gauze; the objection to the former is the difficulty of dissipating the heat; the motors should, therefore, have ample power. The method of using gauze-covered openings cannot be too strongly condemned, as the function of the gauze is not like that in a safety lamp. The use of alternating currents overcomes this difficulty with the motors. Another more important point is the damage to cables, switches, etc. When a cable is severed it means a spark. One attempt to meet this difficulty is to surround the cable with a spiral of insulated wire connected separately to a small fuse, so that when the main cable is torn the spiral stretches and carries the whole current which blows the fuse; but as accidents happen in different ways this is not a complete remedy. The safest way is to run them underground in iron pipes, but even then the pipes may be broken. He concludes that where the mine is fiery, electricity is not suitable owing to the great risk.

Power Transmission.—In an interview with Mr. C. E. L. Brown (of Switzerland) published in the Lond. "Elec. Eng.," Aug. 16, he makes a number of statements of which the following are of general interest: For outputs above 50 kw he always makes his continuous-current machines four-pole or more as he is sure that more economical and efficient designs are thus obtained. In plants in which the main demand is for lighting with a few small motors connected to it, he always uses the single-phase system; when the supply of power and light is approximately equal he prefers the two-phase system and when the power supply predominates greatly he always adopts the three-phase system. Up to 5,000 volts he generates alternating currents directly in the alternator and this pressure he says is sufficient for transmission up to 10 miles; for small motors he transforms down but has built a 110-hp motor for 5,000 volts which has now been running for over a year and is now building one of 65 hp. For the average cost of turbines and water works he estimates $160 to $200 per hp output; for the generating plant including alternators, switchboard, etc., $20; for the line, which is very variable, $10 to $20 per hp; for the total about $220 per hp.

Electrical and Mechanical Transmissions in Workshops.—According to "L'Elettricista," Aug. 1, an interesting and conclusive trial was recently made at the workshops of the Italian army in Rome, with mechanical transmission; for an average load, the power generated was 20 hp of which seven was absorbed in the machines and 13 lost in the transmission; at full load 27 hp was generated, 14 utilized and 13 lost; in an electrical transmission plant the loss would be 3.5 hp for an average load and 6.5 hp for full load. The electrical system is therefore to be used extensively by the military department of the Italian government.

Electric Power Distribution in Harbors.—A long paper by Mr. Grosse is reprinted in full in the "Elek. Anz.," Aug. 4, Aug. 15 and subsequent numbers, and is given in abstract in the "Elek. Zeit.," Aug. 8. He describes briefly, giving technical data, the installations at a number of different European ports, chiefly those of Germany. In some cases the power required, size of motors, etc., are given in the abstract.

Dust Destructors and Thermal Storage.—The Lond. "Elec. Rev.," Aug. 16, contains a brief description of the municipal plant at Shoreditch, in which dust destructors are used in connection with the Halpin system of thermal storage. At first only a partial use of storage will be made, the surplus heat of the destructor going to heat the feed water in enclosed vessels during the hours of light load, this heated feed water being drawn upon during the period of greatest demand. It is estimated that two tons of coal will be required per day for the maximum amount of steam with a simple arrangement of the destructor, whereas with partial storage not more than one ton would be used. The partial storage can, in the future, be extended to the complete system and then no coal whatever will be necessary. Prof. Unwin recently pointed out that in the Halpin system a most remarkable result is obtained in the better efficiency of the boilers, which with the same amount of fuel have an evaporative efficiency at least 15 per cent. greater, and that besides the feed water is practically pure.

Refuse Destruction Applied to Electric Lighting.—A paper by Mr. Manville is reprinted in the Lond. "Elec. Eng.," Aug. 16.

Electric Heating in a Liquid.—At a recent meeting of the International Society of Electricians in Paris, Mr. Gosselin repeated an old experiment of Planté. An electrode forming the positive pole was placed in the bottom of a vessel containing sodium carbonate; the other electrode consisted of a rod of iron or copper which was touched to the surface of the liquid; an arc immediately formed and the metal of the negative electrode was melted off in the form of drops, which were found to be hollow and to contain hydrogen; the voltage was about 250. (If a published description of the original experiment of Planté exists, it follows beyond question that no fundamental patents for this method of electric heating, which has lately come into use, can exist in any country.)

Electricity in Mining.—The "Eng. & Min. Jour.," Aug. 24, comments on a recent paper read in England by Mr. Haws, Lond. "Elec.," July 19, and compares the application of electricity in mining in England as stated in that paper, with the applications in this country. In Great Britain electricity appears to be used on an extremely small scale and is confined chiefly to coal mines, while in the United States, although used more for coal mining, it is applied to metal mining on a much larger scale than it is in England for coal; installations in dangerous, gaseous mines have been very few; in England the wires are run underground while in this country practice is nearly all in the direction of using bare wires; Mr. Haws

claims that it is unsafe to use a voltage greater than 50 for coal-cutting apparatus; 220, 250 and even 500 have been used for years in coal mines in this country. "We would suggest that a few days spent around Scranton and Pittsburg, Pa., for instance, would open the eyes of the English electrical mining engineers to the possibility of electrical mining plants."

The paper by Mr. Haws is reprinted in full in "Elec. Power" for September.

Mining Plant.—An illustrated description of the plant at the Essen Coal Company's mine is published in the "Eng. and Min. Jour.," Aug. 24; it is said to be the largest electrical power plant for coal mining in the United States and one of the largest in the world. Two electric locomotives of 80 hp are used, an illustrated description of which is published in the "Elec. Ry. Gaz.," Aug. 24; they run about eight miles an hour with a draw-bar pull of nearly 4,000 pounds, each capable of hauling 120 tons per day of 9 hours for a distance of 2,000 to 3,000 feet; a special form of mining arc lamp is used.

Electric Welding.—In a short article by Mr. Lackore, published in the "Year Book" of the Univ. of Minn.," May, 1894, he describes the different systems of welding in use, and in conclusion gives some figures of the comparative cost of electrical and fire welding as determined by an English firm which used both methods; the total estimate shows a saving of 24 per cent. in favor of electric welding.

Mining Plant.—The "Eng. Mag." for September contains a descriptive article by Mr. McKay on the Ontario drain tunnel and electric plant at the Ontario and Daly mines in Utah. These deep mines have been drained by a three-mile tunnel, and the water power developed by the drainage water is transmitted electrically by means of the monocyclic system back to the mines and other places; a 60-kw alternator is used generating 2,200 volts at a frequency of 60; the total length of the line is 6.5 miles; the plan was started last February. It is confidently expected that the plant will be made to earn dividends in addition to furnishing its present service free of cost to the owners.

TRACTION.

Accumulator Line.—It is stated that the accumulator line in Paris is to be extended to include some other suburbs.

Steep Gradients on Electric Roads.—The "Elec. Jour." (San Francisco) for August contains an article by Lieut. Stuart-Smith, in which he gives descriptions of methods used in some of the Pacific coast cities. After giving an illustrated description of the well-known Kuhlmann counter-weight system used in Seattle, he gives a detailed description, with illustrations, of the system in use in San Francisco on a 25.5 per cent. grade. There are two tracks on this grade, for cars going in different directions. On the grade there is a conduit like that for cable roads, and it contains an endless cable passing over pulleys at the two ends. An up-going and a down-going car are attached to this cable by the men stationed at the grades, and the two cars then work together by the use of their own motors, the one going down hill assisting the one which is going up. The system was tested Aug. 5 for the first time and was found to operate successfully. It has since been working to perfect satisfaction. It was found that the power of the down-going car is far more than is necessary for hauling the ascending car under any possible conditions of load.

Loss in Hydraulic Gearing.—Referring to the Dey-Griswold gear (see Digest, Aug. 24), Mr. Binney, in the "Elec. Eng.," Aug. 28, asks how the heat generated in that gearing is taken care of. He adds that about three or four years ago there were about 14 original inventors of this system in interference in our patent office. The device was thought to be of great value were it not for the excessive heat generated. In reply Mr. Day says that those referred to were shunt liquid devices, while his invention is an improvement on this. He claims that there is no excuse, except poor designing and workmanship, for having a hydraulic system heat.

Variable Speed Devices.—In an article by Prof. Anthony on "Street Car Propulsion," in the "Elec. Jour." (Chicago), Aug. 15, he discusses in general the problem of obtaining a variable speed from a constant speed motor; he refers more particularly to the liquid gears describing an arrangement which is evidently the one described in the Digest, Aug. 24, and which, he says, is a theoretically ideal arrangement; but he calls attention to a difficulty which lies in the great power which must be required to move the crank pin in order to change the gearing, and he questions whether this can be done by the motorman as rapidly as would be necessary in order to control the car.

Economy of Conductors for Electric Railways.—The article by Mr. Burch, which was abstracted at some length in the Digest, Aug. 10, is published in full in the "Year Book," of the Univ. of Minn., May, 1895. The "jumper" system, which was described, appears to have been devised by Mr. Burch himself.

Testing Railway Circuits.—The "Elec. Jour." (Chicago), Aug. 15, contains an illustrated article by Prof. Shepardson, describing, in an easily understood style, methods of testing with the use of commercial ammeters and voltmeters; it is intended for practical station men.

Prevention of Electrolysis by the Return Circuit.—The "West. Elec.," Aug. 31, publishes a brief article by Mr. Abbott on "Additional Solutions of the Electrolytic Problem," in which he describes and criticises several proposed systems. He states that the three-wire system is defective, as it is impracticable to arrange the load on the two sides of the double-track railway so as to completely balance. The system is applicable only on double-track roads. Mr. Brown's arrangement is described and illustrated (see Digest, March 30). It consists in connecting a generator of about one quarter of the station capacity, with its positive pole to line and the negative to the pipes, the machine generating a few volts more than the rest of the station, thereby always rendering the pipes negative to the rest of the system, thus avoiding electrolytic action. This arrangement is a palliative but not a cure. If there is a high resistance joint in the pipes it becomes a point of inflection for the current, one part being positive and the other negative. In many cases the pipes do not come near enough to the station to render the application practicable. The system proposed by Mr. Farnham (see Digest, Aug. 31), is described and illustrated, being commented on very favorably. The negative pole of the generator is not connected to the ground, the whole generating machinery is carefully insulated, and the negative pole is connected to a set of insulated return feeders, which are connected at frequent intervals to the rails through wires of a resistance which is proportioned so that all the paths of the currents have precisely the same resistance. When pipes are very close to the rails particular care must be taken. The only objection to this system is the expense of the return feeder, but he claims that companies should either obviate damage to underground structures or go out of the business. He believes that the time is coming when no franchise will be granted that does not contain a provision making the railroad company responsible for all injury due to electrolytic action caused by their currents.

Electric and Steam Trains on the Same Track.—"Eng. News," Aug. 29, publishes a brief description by Mr. MacLead, with a number of illustrations, of the railway of the Kentucky & Indiana Bridge Company over the Ohio River; this road is believed to be the only one in the world over which steam and electric trains are regularly operated on the same track. In 1895 electricity replaced steam for the local traffic; the bridge with its approaches is a mile in length, and the total length of the track is 4.11 miles; the bridge has but a single track; 270 trains a day run over these tracks, of which 141 are electric and 129 steam trains; the electric cars are 28 feet long. The experience during the last two years has proved to the satisfaction of the managers that the "safest, cleanest, speediest and most economical method of handling suburban passenger traffic on steam railways is by trolley cars operating on the same tracks with steam trains of all classes, and that this can be done successfully without danger to the trolley cars, or detention to, or interference in any way with, the steam service."

Test of Auburn City Railway Plant.— The "Sibley Jour." for April contains an abstract of a description of a test by Messrs. Walsh and Almy. The following results were obtained; 9.46 pounds of steam per pound of fuel, 3.19 pounds of fuel per indicated hp per hour, 27.34 pounds of steam per indicated hp per hour, the average indicated hp was 80, the average electrical hp 63.04 and the station efficiency 78.8; the fuel used was apparently of an exceptionally good quality. The results of tests show that indicator cards taken by signal from the instrument table are not reliable; they believe the best plan is to use electrically rigged indicators controlled by a push button from the instrument table; another plan, which they consider less reliable, was tried, and consisted in taking cards while the engine was running on a dead load, noting the readings of the elec trical instrument, repeating this for several loads and plotting the results in a curve which gives the current corresponding to every hp; they believe that the same curve may be obtained by the other method just as accurately.

Calculations of the Weight of Accumulators Required for a Railway.—"Elec. Power" for September publishes a translation of the article by Messrs. Chenet and De LaTour, mentioned in the Digest, July 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Edinburgh.—A well-illustrated description of this station is published in the Lond. "Elec. Rev.," Aug. 16; it is one of the most recently opened and one of the newest of central stations in Great Britain; Prof. Kennedy was the engineer throughout. There are under one roof two distinct and separate systems of supply, which were necessitated by the geographical conditions; one is a high-tension alternating-current system, with Ferranti rectifiers for arc lighting, and the other a low-tension three-wire direct-current system in combination with accumulators.

Sunderland—A brief description of this plant, which was designed by Prof. Kennedy, is published in the Lond. "Elec. Rev.," Aug. 16; it is very similar to the Edinburgh station (see above) except in point of size and in that the alternators are driven by continuous-current motors.

Dresden.—A translation of a portion of the article abstracted in the Digest, Aug. 3, is given, with one of the illustrations, in "El'ty," Aug. 28.

Length of Arcs of 500-volt Circuits.—The accompanying table, given without further explanation in the "Elec. Jour." (Chicago), Aug. 15, is the result of some experiments made by the underwriters of Chi-

cago to give some reliable information in regard to the distance of contact on cut-outs and knife switches.

Amperes.	Maximum length at which arcing occurred	Minimum length at which no arc was observed.	Safe Lengths.
10.....	.25 inch.	.50 inch.	1. inch.
20.....	.50 "	.75 "	2. "
30.....	2. "	2. "	2.75 "
40.....	2. "	2.25 "	3.38 "
50.....	2.25 "	2.50 "	3.50 "
60.....	3. "	3.25 "	3.75 "
70.....	3. "	3.33 "	4. "
80.....	3.25 "	3.50 "	4.13 "
90.....	3.50 "	3.75 "	4.38 "
100	3.75 "	4. "	4.50 "

WIRES, WIRING AND CONDUITS.

Commercial Cross-Section of Insulated Conductors.—In an article under this heading in the "Elek. Zeit.," Aug. 8, by Mr. Vogel, he discusses a simple method for determining the most economical cross-section of insulated leads. When not insulated, the best cross-section is easily determined by the usual law, which, however, cannot so easily be applied when the insulation is taken into consideration; but by the present method a very good approximation can be obtained as readily as with insulated wires. From the mean cost of lead-covered leads of different diameters, he finds that the relation follows very closely a straight line aw and therefore a simple equation, the line not passing through the origin; with the aid of simple mathematical deductions, he obtains a formula for the best current density in the cable and by assuming certain constants as the price per metre, interest, depreciation, and number of hours of use during a year, he obtains 7.17 amperes per sq. mm; for certain values of these constants the curve for the cross-section in relation to the current becomes a diagonal line passing through the origin and from the value of these ordinates it is easy to find, algebraically, the cross-section for other values of these constants; the same method may be used for branched leads if the mean current is known.

ELECTRO-PHYSICS AND MAGNETISM.

Dielectric Hysteresis.—"L'Eclairage Elec.," Aug. 3, contains an article by Mr. Hess in which he gives a brief summary of the conflicting results obtained by others; he believes that the question has been settled and that dielectric hysteresis is a hypothesis which has not been verified; the existence of viscosity has not yet been proved; the loss of energy in dielectrics he believes is certainly due to the heterogeneity of the dielectric; in a homogeneous dielectric there is no such loss.

Loss of Energy in Dielectrics.—In the "Zeit. f. Elek.," Aug. 15, Dr. Benischke replies to the article which was abstracted in the Digest, July 27; he claims and endeavors to show that dielectric hysteresis in the sense of the well-known magnetic hysteresis, does not exist; the loss of energy he believes consists of three parts, the loss due to residual charging, to heat due to resistance and to mechanical processes. In the same issue Mr. Eisler replies to these statements.

Graphical Method of Analyzing Harmonic Curves.—The Lond. "Elec.," Aug. 16, contains a short article by Mr. Wedmore; all that is required for its application is an accurate sketch of one complete period of the curve. The method is editorially described as follows: "This curve is subdivided in equal strips parallel with the axis of the function, commonly denoted by *y* and the superposition of these strips on the same base, with the algebraic addition of the ordinates, gives a resultant curve from which certain of the components of the harmonic wave have become eliminated. This subdivision resembles the use of a group-reagent in chemical analysis; since it separates out a family of harmonic components. The use of successive subdivisions, increasing by the series which are the prime numbers, gives a succession of these families of components. And, from the families the individual components themselves are to be separated out." It is also stated editorially that the method is no doubt capable of yielding good and useful results if great care is taken in drawing and superposing the curves, but the process is laborious and when there are many harmonics it takes much time.

Static and Dynamic Sparking Voltages.—An addition to the paper of Mr. Swyngedauw, which was abstracted in the Digest last week, is reprinted in "L'Elec.," Aug. 17, and in abstract, together with the previous paper, in "L'Ind. Elec.," Aug. 10; in the second portion he stated that he believes to be able to conclude from his experiments that the sparking voltage of an exciter which is under the influence of ultra-violet radiations is not diminished appreciably by very small and very rapid variations of the potential.

Action of the Electric Current in Aluminum Wires.—Some interesting experiments are described and illustrated by Mr. Guillaume in "La Nature," Aug. 17. They are based on the fact noticed by Prof. Margot that aluminum wire when heated very hot by the passage of a current through it, behaves differently from wires of other metals; it appears to melt inside while the outside appears to have been transformed into a thin layer of the oxide which forms a sort of protecting coating to the fused metal; such a wire is very flexible and can be used to show the action of a magnet on wires carrying currents; a wire 0.5 mm in diameter and 10 cm long can stand the very high current of 31 amperes, the voltage required being 5.

The Law of the Circuit.—In a paper by Dr. Heinke, reprinted in the "Elek. Zeit.," Aug. 8, he discusses the relation between the three important laws regarding circuits, namely, Ohm's law, the law of the magnetic circuit, and the one regarding that which takes place in electrostatic charging; he shows their relations to the general law that "equalization" is equal to "difference" divided by "resistance."

Magnetic Properties at Different Temperatures.—An abstract from the French of a paper by Mr. Curie is published in the "Jour. Frank. Inst." for August; it deals with iron, nickel and magnetite. The values obtained with iron up to about 756 degrees C. agree with those obtained by Hopkinson; above this temperature the curves showing the relation between the intensity and the field strength are straight lines passing through the origin, up to 1,280 degrees F. (this should evidently have read "C.") after which it decreases more and more slowly; at first the intensity diminishes to half its value for a rise of temperature of a few degrees, and between 950 and 1,280 the susceptibility is almost a constant; but it increases suddenly by 50 per cent. at 1,280 degrees, and then gradually decreases up to a temperature of 1,365 degrees. He offers the following explanation; up to 860 degrees iron behaves like any other paramagnetic body, but at this temperature it begins to change, the transformation being complete at about 920 degrees, at which condition it remains up to 1,280, behaving like oxygen or palladium; finally at 1,280 it suddenly changes back to its first condition. With nickel the temperature of transformation is about 340 degrees, and with magnetite the chief transformation takes place at 535 degrees. From the differences, due to a change of temperature, exhibited by the behavior of diamagnetic and paramagnetic bodies, he considers that these two properties must be attributed to different causes.

Magnetic Declination and Instruments Used for Its Measurements.—The "Year Book" of the Univ. of Minn., May, 1894, contains an article by Mr. Johnson on this subject.

Earth Currents and the Earth as a Dynamo.—In a short article with this title, by Mr. Lang, published in the "Year Book" of the Univ. of Minn., May, 1894, he concludes that the sun may be considered as a magnet and that one factor of the magnetism of the earth is due to the lines of force from the sun; it follows that if a wire is suitably placed on the surface of the earth it cuts this revolving component and thus generates earth currents; the earth may, therefore, be considered a spherical armature; he finds that the voltage induced in a coil of one turn around the earth would be 742; with 100 such turns generating say 60,000 volts, and using a No. 0000 wire, one eleventh of an ampere would flow corresponding to about eight hp.

Alternate-Current Calculations.—The "Year Book" of the Univ. of Minn. for May, 1895, contains an article by Mr. Tanner in which he carries out computations from the results of experiments to illustrate some of the terms and methods of calculation used in alternating-current work.

Hysteresis Due to Magnetic Rotation.—In an article by Messrs. Tenbrock and Schoenbron in the "Sibley Jour." for June, they describe experiments made to decide the question whether the energies lost through hysteresis due to cyclic variations of magnetic induction by charge of direction, as in the Tesla motor, induction motors and other multiphase machinery, were the same as those lost through cyclic variations of magnetic induction by a change of intensity only. A mass of iron was subjected to magnetic induction produced by each of these methods and the energy lost was measured. The apparatus is described in detail. They found an average difference between the results equal to 0.4 watts (the totals are not given) and therefore they conclude that the energies lost are the same whether a rotating or a stationary field is used.

Skin Resistance.—A short abstract of a lecture by Prof. Forbes, which was mentioned in the Digest some months ago, is reprinted in the "Elec. Age," Aug. 31.

Earth Currents and the Earth Dynamo.—The article is reprinted in full in "El'ty," Aug. 28.

ELECTRO-CHEMISTRY AND BATTERIES.

Metallic Lactates for Electroplating—A long paper containing a large amount of tabular data, by Dr. Jordis, read before the second annual meeting of the German Electrochemical Society, is reprinted in full in the "Zeit. f. Electrochem.," July 5, and is abstracted briefly in the Lond. "Engineering," Aug. 16. He showed that lactic acid is an excellent solvent for electroplating although up to the present time experiments have been made only in the laboratory; the deposits are formed uniformly, easily, and adhere so well that there is great hope for a technical process; the expensive free lactic acid is not required; a fairly pure acid can be obtained for $34 a pound. Coatings of copper and brass of varying shades on iron, zinc and copper, of zinc on iron and copper and of iron on nickel, can be obtained without difficulty and require no special apparatus; he does not appear to have been particularly successful with zinc. The process is of interest to engravers and in the silver-plating industry; amalgamated brass in a bath of lactate of silver is covered with a pure white coating which takes a very high polish.

Action of the Current on Fused Sulphides. — A paper by Mr. Garnier from the "Comptes Rendus," 120, p. 184, is abstracted briefly in the Lond. "Elec. Rev.," Aug. 16. He gives an account of some recent results obtained. Crude nickel sulphide was fused in an earthenware tube provided with carbon electrodes and subjected to a current of 23 amperes at 10 volts, the temperature of the furnace being maintained constant. It

was found that the conductivity remained very regular, although the voltage gradually diminished. The sulphide altered in composition, the action of the current being to eliminate to a large extent the sulphide, probably in the form of carbon bisulphide, and to concentrate the remainder at the anode; the nickel "was increased from the anode to the cathode; the copper in the reverse direction, and the iron was slightly increased at the cathode." It is suggested that this might lead to a new and a good process of treating ores of metals consisting of metallic sulphides.

Indirect Electrolysis.—Mr. Rawson, in the Lond. "Elec.," Aug. 16, suggests that the process of indirect electrolysis (see Digest, Aug. 3), is nothing more than the well-known fact that if a metal plate be interposed between the poles of an electrolyte, its two sides are respectively positive and negative, the metal being deposited on the latter, and oxygen or its equivalent set free at the other. If a carbon plate is used in a gold electrolyte it is probable that gold will be deposited only if the impressed E. M. F. is sufficient to decompose the solution of salt and the gold cyanide. Below this value gold would not be deposited. Indirect electrolysis is used in a well-known copper refining process, and also in Prof. Crooke's gold amalgamating process by reversing the currents, every particle of gold between the two poles being alternately cleaned at the positive side and amalgamated by the deposition of mercury on the negative side.

Valency of Mercury and Copper in Electrolytes of Different Concentration.—Dr. Bolton's long article is concluded in the "Zeit. f. Electrochem.," Aug. 5. In his conclusions he states that it follows from his researches that mercury and copper in certain dilutions of some of their salt solutions are dissolved both as diads and monads; this is shown in the electrolysis of iodide and bromide of mercury and in the compound of copper with chloride of sodium and potassium rhodanide; the valency of the metal radical is the same for all concentrations in the following salts: mercury in potassium cyanide and potassium rhodanide, copper in sulphuric acid, copper sulphate, sulphurous acid, sodium thio-sulphate, hydrochloric acid, and in potassium cyanide, iodide and bromide.

Tin-chromic Chloride Cell.—The complete paper of Prof. Skinner is published, with the discussion, in the Lond. "Proc. Phys. Soc." for August.

Burning Lead with Hydrogen.—An apparatus for use in accumulator work is described and illustrated in the "Zeit. f. Electrochem.," Aug. 5.

Electricity Direct from Coal.—In the "Elek. Zeit.," Aug. 8, Dr. Garnier gives a translation of the recent paper by Prof. Bucherer (see Digest, April 6 and May 18), and adds a criticism and further discussion of the subject. He considers that the article of Bucherer has not added much to our knowledge of what takes place in the Borchers cell (see Digest, Dec. 8, 1894), nor of its possible practical development; that the action like that described by Mond (see Digest, Feb. 2), he believes is not correct, as in the Borchers cell the copper electrode did not lose weight, at least in the trial apparatus, while in the Mond combination a consumption of copper takes place. The copper which enters into the reaction of the Borchers cell, he says, is set free from the cuprous chloride by the carbonous oxide and will again be dissolved to form cuprous chloride by the cupric chloride formed at the cathode from the cuprous chloride, so that the electrolyte of the cell will remain free from the cupric chloride and contain a constant quantity of the cuprous chloride, which cannot dissolve copper; he gives what he considers to be the complete equation showing what takes place in the Borchers cell; from this it appears that the carbonous oxide is oxidized at the anode to carbonic oxide and that the solution remains of constant composition; this he says has also been proved by the experiments of Tatlow (see Digest, Feb. 9); whether in large commercial apparatus it is possible to completely prevent the dissolving of the copper, Borchers himself, in reply to a criticism of Reed, says is still a question which must be decided by experiments. The statement of Bucherer that Borchers did not take into consideration the modification of the Thompson law, is of no great importance, as the corresponding correction is very slight in practice. A translation of the complete paper of Mr. Garnier is published in the "Eng. & Min. Jour.," Aug. 24.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Quadrant Electrometer as a Differential Instrument.—The Lond. "Elec. Rev.," Aug. 9, translates in abstract a recent paper by Mr. Arno from the Italian, including formulas and their deduction. Let A, B and C be three points in a circuit, the first two representing the extremities of a resistance, r; if by varying this resistance the two differences of potential between A and B and between B and C will be varied, it is always possible by means of a single experiment with an ordinary quadrant electrometer, which does not require to be standardized, and with a zero method, to determine when these two differences of potential are equal, corresponding to a given value of the resistance. If the two points A and C are connected to opposite quadrants of the electrometer and the point B connected to the needle, there will be no deflection when the two voltages are equal. The method is applicable to alternating voltages as well; a demonstration of this is given. It is strictly correct to apply it not only to alternating currents following a sinusoidal law, but also to others whatever law they may follow. He explains its application to the measurement of electrostatic capacity and induction, for which purpose an inductionless resistance is necessary; this resistance is placed in series with the condenser and with the spiral whose capacity and induction are to be determined, the connections being made as before; when the balance is reached, the capacity in farads, when r is in ohms, is equal to

$$\frac{1}{2\pi n r}$$

in which n is the frequency; if r is the ohmic resistance of the coil which is being measured then the value of the induction of the coil expressed in henries is

$$L = \frac{1}{2\pi n}\sqrt{r^2 - r'^2}\,.$$

The results of a test are given. (Whether a condenser is required in this test, and if so, how it should be used, is not quite clear from the English abstract.)

Direct Measurement of E. M. Fs.—The method and apparatus used by Mr. Limb and described by him in a recent French Physical Society paper, is illustrated and briefly described in "L'Energie Elec.," Aug. 1. He measures voltages by comparing them directly to an induced E. M. F. whose value can be calculated; he used that induced in a coil by an interior permanent magnet revolving around an axis perpendicular to its magnetic axis and the axis of the coil; with this apparatus he determined the values of the standard cells given in the following abstract.

E. M. F. of Standards.—An Academy paper by Mr. Limb is published in "L'Ind. Elec.," Aug. 10, and "L'Elec.," Aug. 17. He measured the absolute value of the E. M. F. of certain standards by the method described in the abstract above and obtained the following values reduced to 0° C.: Clarke 1.4535 absolute volts, Gouy 2.3928, Daniell (Fleming type) 1.0943; the latter increases over 1 per cent. in an hour due to the oxidation of the copper and thus must therefore be freshly prepared for every test; when made in the form of a Callaud cell a remarkable constant voltage is obtained if it is run on closed circuit with a current of about 0.05 ampere per square decimetre of electrode; the Gouy cell is very robust; if by accident it has been treated badly all that is necessary is to short-circuit it for several minutes and then after several hours it will assume its proper value; its coefficient of temperature is very small; Lord Rayleigh's determination of the Clarke cell is 1.4527, which differs only slightly from the above.

Potentiometer.—In a paper by Dr. Raps, reprinted with a good illustration in the "Elek. Zeit.," Aug. 8, he describes, under the heading of a new compensation apparatus, an improved form of potentiometer constructed by Siemens & Halske; it is claimed to require but a very small battery to be independent of temperature, and that the exchange of resistance can be made very readily; measurements are claimed to be accurate to within at least 0.1 per cent.

Magnetic Units.—The Lond. "Elec. Rev.," Aug. 16, reprints two letters by Mr. Heaviside to Dr. Lodge referring to the latter's report, which was published in THE ELECTRICAL WORLD Aug. 3, page 135. He discusses the "4π muddle," the terms voltage and gaussage and the connection between $\mathfrak{H}$ and $\mathfrak{B}$.

Science of Photometry.—The "Elec. Jour." (Chicago), Aug. 15, contains a short article by Prof. Thomas, written in an easily understood style, introductory to the subject.

Daily Insulation Tests of Telegraph Lines.—The article by Mr. Preece, abstracted in the Digest last week, is reprinted in full in the "Elec. Rev.," Aug. 28.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Communication with Lightships.—The article abstracted in the Digest last week, is reprinted in abstract with the illustration, in the Lond. "Elec. Rev.," Aug. 16.

Long-Distance Telephony.—The "Elec. Eng.," Aug. 28, publishes the official map for September, showing the long-distance telephone lines in the United States, which is accompanied by a short article on the growth of the system, from which the following data is taken: According to President Hudson the total investment in telephone property in this country at the close of 1894 was $77,500,000, of which no less than 10 per cent. is in the long-distance service; this to-day includes 55,000 miles of pole line and 265,000 miles of wire, the construction being of the very latest and best type; the standard size of wire is No. 12 B & S, 0.104-in. diameter, of hard drawn copper, having a resistance of 5.2 ohms to the mile; the poles are 40 feet and the spans 130 feet. There are over 2,000 places connected by metallic circuit with this system; in referring to the rates charged it is shown that $9 for five minutes between New York and Chicago, representing about 750 words, compares well with telegraphy; even at this undeniably high tariff, it is believed that the advantage still rests with the telephone; it is stated that the habit of telegraphing does not gain ground while telephonic intercourse grows at an extravagant rate; the average of about one telegraph message per year per head of population appears to remain steady in this country and in cities it falls below that; even in England the ratio is only two messages per head. Every 24 hours the telephone is used more than two million times, or about 25 per cent. of the adult population of the United States use it daily. The reason that so little has been done in this country with

combined systems of telephoning and telegraphing is attributed to the fact that there is a tendency to pass from complexity to simplicity.

Agreement between the Bell and the Western Union Companies.—"Elec. Eng.," Aug. 28, publishes in full the text of the famous agreement made in 1879 and comments on it editorially. It appears that the telephone company has paid to the telegraph company a commission of 20 per cent. on its gross rental income for the privilege of doing business free from vexing competition; the amounts paid are given and including this year they are estimated to amount to $7,225,000 for the 15 years "as the consideration for which it agreed to sit still and do nothing in telephony."

Invention of the Telephone.—The "Year Book" of the Univ. of Minn., May, 1894, contains a short lecture by Mr. Brooks on "The Electric Telephone," in which he gives briefly a general description of the telephone. Regarding its invention he states that it is not generally known that Dr. S. D. Cushman, now living in Chicago, invented a magneto-speaking telephone in the year 1851; it consisted of an electromagnet with a piece of sheet iron over it but not quite touching it; the apparatus was intended to show whether the telegraph lighting arresters had performed their work; it appears that signals were exchanged by tapping on the sheet iron with their pencils after which various sounds were transmitted and even spoken words. He also reprints a translation of an article by Mr. Boursule printed in "L'Illustration," Vol. 24, Paris, Aug. 26, 1854, in which he suggests that spoken words might be transmitted electrically and suggests that if a man speaks near a movable flexible disc which alternately makes and breaks a connection with the battery, there may then be another disc at a distance "which will simultaneously execute the same vibrations. . . . However this may be, it is certain that in a more or less distant future speech will be transmitted by electricity.' Mr. Brooks also states that in Bell's first patent no mention is made of artificial speech, a fact which was acknowledged in the opinion given by Chief-Justice Waite.

Different Forms of Telephone.—The "Year Book" of Univ. of Minn., May, 1894, contains a short article by Messrs. Ford and Walker, in which they give brief descriptions, without illustrations, of the telephones in successful operation in this country and abroad.

Machine Telegraphy.—The Delany system is described, without illustrations, in "Elec. Power" for September.

MISCELLANEOUS.

Diphtheria.—At a recent meeting of the International Society of Electricians in Paris, Dr. d'Arsonval in giving a new example of the application of electrolysis in medicine, stated that in Berlin it was found that the contagious material of diphtheria can be made harmless by an electrolytic process, without having to resort to successive cultures.

Biographical.—A large full-page portrait of Michael Faraday is published in the "Elec. Jour." (Chicago), Aug. 15. A biographical sketch with portrait of Prof. Geo. D. Shepardson, professor of electrical engineering at the Univ. of Minn., is published in the "Year Book" of that university, May, 1895.

Educational.—"Elec. Power" for September contains an article by Mr. Perry on "How Shall We Educate Our Sons for the Electrical Profession"; he outlines the general features and not the details, of the education which a young man should strive to attain to become an electrical engineer.

New Books.

Hall's Infringement Outline. By Thomas B. Hall, New York: Banks & Bros. 90 pages. Price, $1.

The object of this work is to provide for inventors, patent attorneys and others interested in the protection of inventions by letters-patent, an outline of the law of patent infringement as far as settled by decisions of the Supreme Court of the United States. The subject matter comes under four heads, as follows: License under Patent, Identity of Invention, Validity of Patent, and Recovery for Infringement. Each of these subjects is treated under subheads, that on the validity of patents being considered at greatest length.

The work is concisely and clearly written and forms a very convenient compendium of the decisions upon the law of infringement, references being made to over 700 cases—all the cases, in fact, under 35 divisions, which have been in the Supreme Court down to April 20, 1895. The typographical work is excellent and the book is very substantially bound in cloth and is of a most convenient size for a handy reference book.

Special Agents' Electrical Handbook. Dealing with electricity, in its bearing upon insurance inspectors, and treating in a general way of the more common deficiencies encountered, their possible effects, and how they may be avoided. By A. M. Schoen. New York: The Spectator Company. 113 pages, 36 illustrations. Price, $1.

This book is intended for the use of fire insurance inspectors. It describes, in a popular manner, the various devices found in electric lighting and power plants, with their functions. It calls attention to many of the various appliances and methods which rascally or ignorant contractors are apt to employ, and shows wherein they are defective.

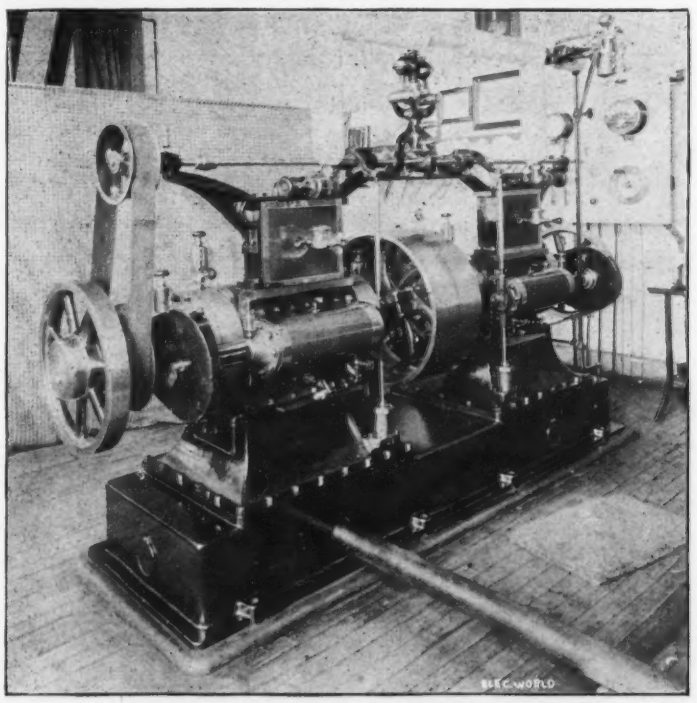
Capital and Labor.

Mr. R. T. Crane, president of the Crane Company, and also of the Crane Elevator Company, of Chicago, delivered an interesting address to his workmen on the occasion of a picnic held July 4 of this year, to celebrate the fortieth anniversary of the opening of his business. Mr. Crane referred to the vast differences in business methods of the present day and forty years ago, and to the great growth of competition as compared with the former period, when each manufacturer had practically a definite territory of his own. He deprecated the attempt of agitators to array employees against employers, and does not believe the claim that the average manufacturer is to-day more prosperous as compared with the workingmen than forty years ago. The harmony which should exist between employers and employees was dwelt upon, and shown to be a proper consequence of a rational interpretation of sound economic principles.

In conclusion Mr. Crane suggested that just as surely as the farmer and mechanic and artisan and laboring man make up the mass of the people of this country, just so surely does the future of this country and the continuance of our institutions depend upon their will. If they seek to array class against class, faction against faction, section against section, to adopt and enforce legislation that will deny their rights to one class of a community while guaranteeing them to another class, just so certainly will this republic of ours become a memory, and in its place and on its ruins be created the despotism of anarchy, to be supplanted in turn by the despotism and tyranny of an absolute monarchy.

Automatic Cut-Off Rotary Engine.

We illustrate herewith an automatic cut-off rotary engine, the invention of Mr. Charles A. Fisher, of Petersburg, Ill., and which is now on exhibition at the Cadillac Hotel, Detroit. The engine was built by Leland & Faulconer, under Mr. Fisher's supervision, and has been in constant service since the 15th of May. The first engine of this type was built in Chicago in 1891, the cylinders being 5 inches by 5 inches, and has been in use in the experimental laboratory of Messrs. Fisher & Abbott, at Petersburg, Ill., since that time, furnishing power for their laboratory. It is claimed that the engine is economical in the use of steam, regulates exceedingly closely and has a mechanical efficiency of 97 per cent. Its design is such that parts subject to wear can be replaced at small cost, and as there are no steam joints to be maintained by soft packing, but little attention is required in its operation. Its construction also admits



Automatic Rotary Engine Curve for Determining Economic Size of Feeders.

of perfect balancing of all the parts, which obviates the necessity of the usual foundation.

The dimensions of the engine shown in the illustration are as follows: Base, 8 feet by 28 inches; height to centre of driving shaft, 32 inches; extreme height, 6 feet; total weight, 2 tons; rating at 350 revolutions per minute, 50 hp. The two cylinders have each a diameter of 12 inches, and a length of 21½ inches, the mean area of the piston being 32.25 inches. The main valve is driven by a gear from the driving shaft of the engine in the ratio of two revolutions of the engine to one of the valve. The variable cut-off main valve is arranged to be rocked by the action of the governor employed, as the load may demand. By an ingenious device indicator cards have been taken from the engine, and they show an efficient distribution and working of the steam.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Aug. 24, 1895.

THE PROMISING BUSINESS SITUATION is reflected in the general stock market, there having, during the week. been many considerable advances and but few declines. Predictions are freely made that the buoyant state characteristic of the August market will be even more marked during the coming month, and advances occur all along the line. General Electric closed ⅞ higher than the quotation for the previous week. Trading in Electric Storage was brisk, the stock closing at 47, an advance of 1¾ over the figure of last Saturday. The movement in tractions was irregular, and the advance in Philadelphia Traction ascribed to inside buying.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	98	100
" " " Brooklyn	100	110	115
" " " Boston	100	150	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	47	47½
General Electric	100	37½	37⅝
General Electric, pref	100	69	71
Westinghouse Consolidated, com	50	36	36
" " pref	50	54	55

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	..	198
American District Telegraph	100	30	40
American Telegraph & Cable	100	96	100
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	54	54½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	88	90
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	94	..

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	20	20¼
Binghamton RR. com	100	100	..
Brooklyn Traction	100	15	18½
" " pref	100	..	53
Buffalo St. Ry	100	88	91
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	25	27
Electric Traction, Philadelphia	50	74	75
Hestonville	100	59	59¼
Long Island Traction, 1st in pd	100	15	15½
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	24	27
" " pref	100	79	81
North Shore Traction	100	34½	36
" " pref	100	84	88
People's Traction $30 pd	25	66¾	66⅞
Philadelphia Traction	50	85⅛	85¼
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	76¼	76½
" " pref	100	92	92½
Worcester Traction	100	18	20
" " pref	100	86	90

BONDS.

Buffalo St. Ry. 1st con. 5s	100	106	109
*Binghamton Railway Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	104	..
Rochester St. Ry. 1st 5s	100	95	97
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Aug. 26, 1895.

THE CHESLEY ELECTRIC COMPANY, Hoboken, has closed a contract with the American Sugar Refining Company to rebuild three 30-kw Edison dynamos which have been in a fire.

MESSRS. CROCKER & WHEELER, Ampere, N. J., report that after a continuous run, excluding Sundays, of a thousand hours, they have almost caught up with their orders, which since their fire are stated to have been nearly twice as large as ever before. They have also nearly replaced their stock of parts, and are therefore able to serve customers with greater promptness than has recently been possible.

MR. OSBORN P. LOOMIS has severed his relations as treasurer and electrical engineer of the American Engine Company, of Bound Brook, N. J. During his connection with that concern the generators and motors of his design and build have been very successful, and these machines, both bipolar and multipolar, are now in use all over the country. He has had some very flattering offers, but has not decided at present what step to take.

THE J. GRANT HIGH COMPANY, of Philadelphia, has established a New York office at the Electrical Exchange Building, 136 Liberty Street, Rooms 103 and 104, and has appointed Mr. Chas. E. Chapin and Mr. J. S. Douglas managers, who will conduct the business under the firm name of the Chapin-Douglas Electric Company. Mr. Chapin is too well known to need an introduction to the electrical trade. Mr. Douglas graduated from the School of Mines of Columbia College, where he took the course in electrical engineering, and was for two years in the employ of the Western Electric Company.

ANOTHER UNDERGROUND CONDUIT ROAD.—A scheme is in contemplation whereby the Eighth Avenue line of horse cars may be superseded by an underground trolley system to extend from Canal Street to the Harlem River. Ex-State Senator George W. Plunkitt, who is named as the originator, in a recent interview stated that he believed that an underground trolley will be put in Eighth Avenue in place of the horse car line, though some directors of the Eighth Avenue line are satisfied with having a smaller dividend rather than a temporary break to secure a larger. The plan is not hostile to the Eighth Avenue line. On the contrary, a change must be made for the line's sake. Competition from the cable and elevated roads is lessening its value. The system will be the underground after the Budapest manner, but with improvements.

AN INTERESTING LAMP CASE.—Last week Judge Jerome sentenced Thomas Jones, of 329 Stanton Street, to six months' imprisonment, and Jeremiah O'Brien, of 402 East Tenth Street. and John Tracy, of 213 Lewis Street, to four months each in the penitentiary, for endeavoring to steal lamps from the Edison Illuminating Company. It is the custom of the illuminating companies to give to their customers new lamps for those burned out, and on Friday afternoon, Aug. 23, O'Brien and Tracy brought a large box of burned-out lamps to the Twenty-sixth Street station of the Edison Company and, stating that they came from the Manhattan Club, asked to have them exchanged. As the Manhattan Club was not a customer of the Edison Company, and, moreover, as a large part of the lamps were not Edison lamps, the request was refused. The men took the box to Broadway, where O'Brien was waiting with a truck, and while driving through Fourth Avenue and the Bowery the three shied the lamps, not of Edison make, at street venders and passers-by, and in so doing hit one of the Edison employees who had been directed to follow the men. The Edison scouts who had been following them up, thinking that perhaps they would attempt to exchange the lamps at the Edison station in Duane Street, notified the superintendent there, and when Tracy and O'Brien arrived they met with a cordial reception. The men there represented that the lamps came from Childs' restaurant in Cortlandt Street. The police were notified and arrested Jones, who had remained outside the building awaiting developments, together with Tracy and O'Brien, who had been detained in the building. One of the latter made a break for liberty, but ran into the arms of a stout employee who had been placed at the door in the event of such emergency.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Aug. 26, 1895.

W. S. ARMOUR, formerly of the Detroit Motor Company, has made arrangements to again represent that company in this territory.

KERITE WIRES.—On and after Sept. 1 next, the general western agency for Kerite wires and cables will be exclusively in the hands of Mr. S. F. B. Morse.

MR. L. K. COMSTOCK, of the L. K. Comstock Company, of Chicago, has just returned, after making a lengthy tour of the East. He reports the business outlook for him this fall as very encouraging.

THE ELECTRIC APPLIANCE COMPANY reports that it is making a special effort on telephone line material, including copper and iron line wire, pony glass insulators, pins, brackets and cross-arms; shipment in all cases being promptly made from Chicago stock.

BIDS ARE BEING RECEIVED by H. E. Roach & Son, architects, St. Louis, Mo., for a complete steam and electric plant for the building of J. E. Liggett, St. Louis, Mo. The electrical equipment will include two small direct connected sets. Plans and specifications for same and electrical plant by Pierce & Richardson. Plant to include either steam or electric elevators.

MR. JOHN R. MARKLE, who has for the last year represented the Electric Storage Battery Company as Western manager, left Aug. 26th for Gibbonsville, Idaho, where he will spend several months looking after his personal interests. Mr. Markle has severed his connection with the Electric Storage Battery Company, and will devote his time exclusively to looking after properties in which he is interested.

Canadian Notes.

Ottawa, Ont., Aug. 23, 1895.

OTTAWA, ONT.—Arrangements have been completed for extending the Ottawa Electric Railway to Hintonburgh.

OTTAWA, ONT.—The yearly report of the Ottawa Car Company shows a net profit of 12 per cent. on capital invested.

THREE RIVERS, QUE.—A charter has been issued incorporating the St. Maurice, Champlain & Three Rivers Counties Telephone Company.

MONTREAL, CAN.—Tenders are wanted for lighting the town of Ingersoll by gas or electricity. Address chairman of the fire, water and light committee, Ingersoll.

AYLMER, QUE.—With a capital of $60,000, the Deschenes Electric Company is applying for a charter for the purposes of operating works to produce electricity for light, heat and power. R. H. Conroy, W. J. Conroy and J. C. Nelson to be the first directors.

MONTREAL.—The management of the Montreal General Hospital are now considering the question of installing an electric plant for the better and more economical lighting of the hospital. A report favorable to the adoption of certain plans has been submitted.

VANCOUVER, B. C.—The City Council has received a communication from W. T. Stewart regarding the lighting of Vancouver with electricity by the Western Electric Light, Heating & Power Company. The offer is to furnish light for ten years at 27½ cents per lamp of 2,000 cp per night.

PARRY SOUND, ONT.—The Parry Sound Electric Light, Heat & Power Company, with a capital of $20,000, is applying for a charter to supply electric light, heat and power to the town of Parry Sound. W. H. Pratt, S. A. Armstrong, John Galna, J. J. Jolliffe and D. W. Ross are the first directors.

CHARLOTTETOWN, P. E. I.—E. F. Clements, representing the Standard Telephone Company of New York, is at present trying to obtain consent from the Prince Edward Island government to construct a transcontinental telephone system in that province. It is intended landing the cable at Cape Traverse. Mr. Clements is also negotiating for a franchise to construct an electric street railway system in this city, with American capital.

TORONTO.—Litigation over an invention for the electric propulsion of cars has been commenced by a suit entered on behalf of J. Firth Jeffers against Archibald H. Brintnell. Last February, by an agreement then entered into, the former claims to have become entitled to a one-half interest in the invention for Canada, United States and Great Britain, and a three-eighths interest in France, Belgium and Italy. These claimed interests, however, the defendant declared, expired by a certain lapse of time. The plaintiff has obtained an injunction to prevent the defendants dealing with the interests claimed until after the trial. The invention has already been patented.

OTTAWA, ONT.—Robert Anderson, who has done a large amount of work for the Dominion government, has now the contract for putting in a lightning rod, copper stranded cable, 1,000 feet in length, on the MacKenzie tower of the government buildings here. He has also just closed a contract for putting in an electric light plant in the big lumber mills run by M. C. Edwards & Co. He has done a large amount of work for the lumbermen, and finds that preference is now given to incandescent lights over the arc lights, as a better distribution is obtained. He has nearly completed the installation of a street light and incandescent plant at Vankleek Hill, Ont. He has also just completed a contract for supplying an incandescent plant in the large establishment of Geo. Mathews & Co., Hull.

English Notes.

[FROM OUR OWN CORRESPONDENT.]

London, Aug. 21, 1895.

ELECTRIC MANUFACTURING BUSINESS.—The profits which accrue in this country from electrical manufacturing still continue of a somewhat microscopical order; only one or two firms at the present moment are paying dividends, and the majority of them are, like Messrs. Crompton & Co., not only not paying, but doing something very much like losing.

LIVERPOOL OVERHEAD RAILWAY.—This company has recently paid a dividend at the rate of 2¼ per cent. per annum for the half year ending June 30. The traffic receipts, though not the traffic, continue to show an increase, the fares having been raised during a certain part of the day. The increased revenue of over £8,000 cost about £4,000 to earn, that is to say, the ratio of expenditures to receipts was about 50 per cent. for this portion of the income. The ratio for the total income being over 66 per cent., it will be seen that the increased earnings of this company are costing it comparatively little.

THE TELEPHONE IN ENGLAND.—An interesting investigation has recently been made in this country by Mr. G. L. Addenbrooke in which he shows that the wages paid by the National Telephone Company to its employees are in many cases actually less, and in but few cases appreciably higher than the corresponding wages paid on the Continent, and Mr. Addenbrooke is inclined to argue from this that there is no excuse, therefore, from the point of view of the cost of labor, for the relatively high rates which prevail in this country. To prove his case, however, Mr. Addenbrooke will have to show that the cost to the company, for getting a given amount of work done, is not greater than on the Continent. This may be so, but it has not yet been conclusively shown. When it is, it may be assumed that the comparatively high rates prevalent in this country are due to mismanagement and inflated capital; causes which will not call for any mercy at the hands of the public in the matter of forcing low rates.

General News.

New Incorporations.

THE BRYANT ZINC COMPANY, Chicago, Ill., has been organized for the purpose of manufacturing and selling electrical and other articles. The promoters are George Bryant, W. W. Salmon and J. A. Wilson.

THE HERMANN ELECTRIC LIGHT COMPANY, Hermann, Mo., capital stock $8,000, has been incorporated for the purpose of supplying electric light, etc., by A. C. Leisner, George Mittendorf, Theo. Graf, Hermann, Mo.

THE HINSDALE ELECTRIC LIGHT WORKS, Chicago, Ill., has been incorporated to furnish light, heat and power to the village of Hinsdale, by Henry A. Gardner, Frank E. Bradley and Arthur M. Morgan. Capital stock $2,000.

THE CONSUMERS' ELECTRIC COMPANY, Seattle, Wash., has been formed to produce. transmit and furnish electric light, heat and power. The promoters are Thomas Boyd, A. M. Brooks and W. J. Grambs. Capital stock $50,000.

THE PEOPLE'S ELECTRIC LIGHT, HEAT & POWER COMPANY, Avoca, Pa., has been formed to supply light, heat and power. The promoters re James Butler, John A. Gillick, Michael J. McDonald, Moosic, Pa. Capital ock $25,000.

THE BETHEL ELECTRIC LIGHT & POWER COMPANY, Bethel, Vt., capital stock $15,000, has been incorporated for the purpose of furnishing light and power, by W. H. Creamer, A. A. Brooks, R. M. Chase, M. A. Moody, George H. Fupper, Bethel, Vt.

THE LE ROY HYDRAULIC ELECTRIC COMPANY, Le Roy, N. Y., capital stock $65,000, has been incorporated to manufacture electricity for light, heat and power. The incorporators are C. F. Prentice, D. C. Howard Prentice, C. N. Keeney, all of LeRoy, N. Y.

THE AMBER INVESTMENT COMPANY, Tacoma, Wash., capital stock $50,000, has been formed for the purpose of dealing in real estate, electrical and street railways. The incorporators are Arthur C. Prichard, F. Bryant, F. C. Taylor, F. J. Miller and R. C. Applegate.

THE ASCHER HEATING & PLUMBING COMPANY, Des Moines, Iowa, capital stock $25,000, has been formed for the purpose of carrying on business connected with plumbing, gas fitting, electric light fitting and steam fitting. Those interested are O. K. Ascher and Will Scoville.

THE COLORADO ELECTRIC HEATING COMPANY, Denver, Col., has been formed for the purpose of supplying apparatus of all kinds for electrical heating, electric lighting and electric power. The promoters are George B. Frally, J. S. J. Lallie, F. C. Ticknor. Capital stock $100,000.

THE KANSAS & ARKANSAS CONSTRUCTION COMPANY, Kansas City, Kan., has been formed to erect buildings, electric light and gas plants, and to build and equip railways. Those interested in the project are W. W. Atkins, B. L. Short, C. A. Ellis, J. J. Spencer, Kansas City, Kan. Capital stock $50,000.

THE FORT WAYNE, LAKE EVERETT & COLUMBIA CITY STREET RAILWAY COMPANY, Fort Wayne, Ind., has been incorporated by Charles E. Everett, Wallace Dowd and William Geake, for the purpose of building, equipping and operating an electric street railway in Fort Wayne. Capital stock $300,000.

THE OSCEOLA ELECTRIC LIGHT COMPANY, Osceola, Iowa, has been incorporated by J. R. Harrison, A. W. Lewis, John W. Hall, D. Goldsmith and W.H. Hall, for the purpose of owning, operating and maintaining an electric light plant, and selling, buying or leasing real estate on which to put the plant. Capital stock $20,000.

THE PUNTA GORDA ICE & POWER COMPANY, Punta Gorda, Fla., has been formed for the purpose of manufacturing and selling ice and for the transmission and delivery of electric light and power. Those interested in the project are J. H. Farrington, William S. Stetson, Lorenzo T. Blacksom, Punta Gorda, Fla. Capital stock $10,000.

THE KOOTENAI MINING & MILLING COMPANY, Spokane, Wash., has been incorporated for the purpose of mining, milling and dealing in mineral products and electric light plants. The promoters are Frank H. Gordon, Spokane, Wash.; B. E. Barinds, William H. Cawkey, Detroit, Mich.; John D. Farrell and Albert E. Humphreys. Capital stock $1,000,000.

THE PORT CHESTER, RYE, HARRISON & WHITE PLAINS ELECTRIC RAILWAY COMPANY, Port Chester, N. Y., has been incorporated for the purpose of constructing and operating an electric street railway. The incorporators are J. W. Lounsbury, Port Chester; John Duffy, John O'Rourke, F. G. Schirmer, White Plains, N. Y. Capital stock $250,000.

THE CLARKSVILLE COTTON OIL COMPANY, Clarksville, Tex., has been formed with a capital stock of $50,000, to manufacture and sell cotton and other products, and to supply the city with water and electric light, also to make and sell ice. D. W. Cheathan, J. M. Aydelotte, Jos. M. Sivley, Jno. W. O'Neall, Clarksville, and F. H. Bailey, Paris, Tex., are interested.

THE ELLIOTT MAGNETIC ELECTRIC COMPANY, Chicago, Ill., capital stock $1,000,000, has been organized to manufacture and sell the Elliott magnetic electrical and mechanical appliances for railway and other purposes, and

to sell the right to manufacture and sell the said appliances. The incorporators are William R. Elliott, Isaac C. Robbins and Charles A. Emmons.

THE NEW BETHLEHEM ELECTRIC COMPANY, New Bethlehem, Pa., has been formed to supply electric light, heat and power. The incorporators are John B. Thompson, George L. Thomas, C. E. Andrews, W. M. Andrews, J. R. Foster, C. A. Berger, R. F. Mateer, F. L. Andrews, W. J. Mateer, S. Taylor Sheaffer, New Bethlehem, Pa. Capital stock $1,000.

THE HASBROUCK HEIGHTS LIGHT, HEAT & POWER COMPANY, Hasbrouck Heights, N. J., has been incorporated to make and sell gas for lighting streets, manufacture electricity for heat, light and power. Those interested in the project are Edward M. Anson, George Broughton, Jr., Hasbrouck Heights, N. J., Jules F. Valois, New York City. Capital stock $50,000.

THE COLUMBIA COUNTY ELECTRIC RAILWAY COMPANY, Greenport, N. Y., capital stock $400,000, has been incorporated to build and operate an electric railway 15 miles long, connecting Hudson, Philmont and Stockport Station. The incorporators are Hiram McGonegal, New York City; W. S. Wales, Syracuse; A. J. Romles, Hudson; W. H. Van Tassel, Hudson, N. Y.

THE CITY OF WEATHERFORD WATER, LIGHT & ICE COMPANY, Weatherford, Tex., capital stock $80,000, has been organized to supply water and electric light and motor power to citizens and to manufacture and sell ice. The incorporators are M. H. Arnst, Platt V. Bryan, Elmira, N. Y.; G. A. Holland, W. P. Anderson, Weatherford, Tex., and W. T. Hudgins, Texarkana, Tex.

THE ISLAND POND ELECTRIC LIGHT & POWER COMPANY, Island Pond, Vt., capital stock $10,000, has been formed for the purpose of acquiring and owning real estate and conducting all transactions incident to general electric lighting business. Those interested in the project are George H. Fitzgerald, Z. M. Mansur, H. E. Fitzgerald, L. A. Cobb and E. W. Bartlett, Island Pond, Vt.

THE WINCHESTER GAS & ELECTRIC LIGHT COMPANY, Winchester, Mass., has been formed for the purpose of manufacturing and generating gas and electricity for lighting, heating, cooking and furnishing mechanical power. The incorporators are Lewis C. Pattee, president; David N. Skillings, treasurer; Hales W. Suter, N. T. Apollonio and F. J. O'Hara. Capital stock $50,000.

THE CALIFORNIA LIGHT & FUEL COMPANY, capital stock $300,000, has been incorporated at Los Angeles, Cal., for the purpose of constructing, acquiring and selling electric light, gas and fuel works and the prosecution of various other lines of business. The incorporators are Thaddeus S. C. Lowe, Leon P. Lowe, H. C. Brown, of Pasadena; C. W. Cochran and J. M. C. Marble, of Los Angeles.

THE DENVER, GLOBENVILLE & GOLDEN RAPID TRANSIT COMPANY, Denver, Col., capital stock $100,000, has been formed to construct and maintain street railway lines and to operate them by electricity, cable, gas or any other motive power. The incorporators are Lewis E. Lemen, George S. Parsons, Irving F. Root, Denver, Col.; R. C. Lingo, North Denver, Col., and S. R. Wright, Highland, Col.

THE CITIZENS' TELEPHONE & ELECTRIC COMPANY, Hoboken, N. J., capital stock $50,000, has been incorporated for the purpose of constructing, operating and maintaining telephone and electric service lines in Hudson county, and for the transmission of electric light, heat and power. The incorporators are William H. Elles, John Ryan, John J. Cuddiley, Hoboken, N. J., and Morris Frankford, New York City.

THE BROTHERS ELECTRIC CABLE CRANE COMPANY, Newark, N. J., capital stock $6,000, has been formed to manufacture, buy, sell and deal in electric cables, cranes, electric apparatus, cars, boats, engines, boilers, motors, and all kinds of machinery, life-saving apparatus, etc. The promoters are Wm. F. Brothers, Sarah E. Brothers, 1151 Fulton Street, Brooklyn, N. Y.; Isaac R. Brown, Jr., Maria A. Brown, Plainfield, N. J.

THE STANDARD CAR SEAL & EQUIPMENT COMPANY, Jersey City, N. J., has been incorporated for the purpose of purchasing, manufacturing and selling car seals for the sealing of cars in use upon railways and tramways either operated by steam, electricity or other motive power. The incorporators are George H. Ford, Frederick B. Bard, Brooklyn, N. Y., and Charles N. King, Jersey City, N. J. Capital stock $25,000.

THE DAMUELS DYNAMITE ACCUMULATOR COMPANY, New York, N. Y., has been incorporated in the State of West Virginia for the purpose of manufacturing and selling electric storage batteries in the United States and Canada. The incorporators are William Seward Webb, Shelburne, Vt.; John Jacob Astor, Henry L. Sprague, Henry B. Ely, Charles H. Burnett, New York City. Capital stock $500, minimum; $5,000,000, maximum.

THE WOOSTER, MEDINA & CLEVELAND STREET RAILWAY COMPANY, capital stock $10,000, has been incorporated at Wooster, O., for the purpose of operating an electric railway through counties of Wayne, Medina, Summit and Cuyahoga. The incorporators are L. P. Ohlinger, F. H. Harding, J. R. Zimmerman, C. W. Kauke, A. Cunningham, C. V. Hard, W. J. Mullins, Charles W. Faircett, A. D. Metz and A. M. Parish. Date of certificate, Aug. 21, 1895.

THE BRYAN, HICKSVILLE, MAYVILLE & FORT WAYNE RAILWAY COMPANY, Hicksville, Ohio, capital stock $50,000, has been organized for the purpose of building and operating an electric railway in Williams and Defiance counties, Ohio, and Allen County, Ind. Those interested in the project are F. W. Horton, C. F. Swift, J. B. Colegrove, W. G. Deastman, John W. Winn, George C. Serrill, John S. Hart, M. N. Hootman, W. H. Harter, J. J. Dorsey and R. M. Simmons.

THE KAWEAH IRRIGATION & POWER COMPANY, Visalia, Cal., capital stock $300,000, has been formed to acquire, buy and sell water and water rights, furnish power developed by water, electricity or other means, acquire, construct and operate electric railways and electric plants, and to carry on a general manufacturing and merchandise business. The incorporators are Elisha C. Ware, Chicago, Ill.; A. C. Wishon, Tulare; George Hanna, John A. Pirtle, Los Angeles, and O. C. Ainsworth, Pasadena, Cal.

THE BURTON ELECTRIC COMPANY OF CALIFORNIA, San Francisco, Cal., has been formed for the purpose of supplying electricity for the heating, forging, smelting, welding and working of metals, minerals, ores, chemicals and gases; dealing in all kinds of electrical machinery, inventions and manufacturing and dealing in machine tools. The incorporators are George C. Perkins, J. R. Kendall, Oakland; John C. Richards, N. A. Harris, George E. Davis, San Francisco; C. A. Warner, San Francisco, and George D. Burton, Boston, Mass. Capital stock $1,000,000.

TELEGRAPH AND TELEPHONE.

PAINESVILLE, O.—Painesville is to have a new telephone exchange.

COLORADO SPRINGS, COL.—The Colorado Automatic Telephone Company is to be organized.

LOUISBURG, PA.—The new telephone company has received its charter and is putting up its lines.

ANN ARBOR, MICH.—The Automatic Telephone Company has commenced business with 52 subscribers.

ZANESVILLE, O.—The Central Union Telephone plant will be improved at once, at an expense of $30,000.

COUDERSPORT, PA.—A movement is in progress to organize an automatic exchange telephone company at Coudersport.

FORT DODGE, IOWA.—The Phœnix Telephone Company has received a franchise and will soon begin active operations.

SPRINGFIELD, MASS.—An agent of the Standard Telephone Company is soliciting subscriptions to its stock, with a view to establishing an exchange.

SAGINAW, MICH.—The Saginaw Valley Mutual Telephone Company has applied for a thirty-year franchise to own and operate a telephone exchange in this city.

EAST ST. LOUIS, ILL.—E. A. Woelk, manager of the Bell Company for St. Claire and Madison counties, has decided to place all telephone wire underground.

FRANKFORT, KY.—The American Long-Distance Company has been granted right of way over the streets of Frankfort. Wires and poles will be put in at once.

SUMMIT, N. J.—Mr. Walter I. Sweet, of the New York & New Jersey Telephone Company, is making a canvass preparatory to putting in a local telephone exchange.

SANTA CRUZ, CAL.—The City Council has granted a franchise to the Popular Telephone Company, which will pay one cent per month to the city for each telephone in use.

CLEVELAND, OHIO.—Col. William P. Fogg, said to be a representative of a wealthy New York syndicate, is organizing a telephone company to compete with the Bell Company.

ASHLAND, WIS.—The new telephone company expects to use long-distance instruments and connect with systems in Oshkosh and other points in the southern part of the State.

KENOSHA, WIS.—At a meeting of the Common Council the ordinance granting a telephone franchise to the National Telephone Company, of Milwaukee, was given its first reading.

BARABOO, WIS.—A stock company, to be known as the Baraboo Telephone Company, has asked the city for a franchise to put in a telephone exchange. Articles of incorporation have been applied for.

SHEBOYGAN, WIS.—The franchise which was granted Messrs. End, Johnson & Winter, who intended to build and operate a new telephone system in Sheboygan, has not been accepted by that firm.

CLINTON, TENN.—The Clinton Telephone Company has organized by electing Dr. R. K. Medaris president and general manager, D. R. Powers vice-president, S. L. Slover, secretary, and R. A. Shifflet, treasurer.

WABASH, IND.—The new telephone company has nearly completed its plant and has 133 yearly subscribers. The Bell Company has reduced its rates for business houses to $1, and for private residences to 66 cents per month.

THE W. J. KURTZ CONSTRUCTION & MANUFACTURING COMPANY, Vandalia, Ill., announces that it is now ready to undertake the installation of telephone plants throughout the United States on the underground system.

CHESTER, PA.—The Delaware County Telegraph & Telephone Company, recently organized, and which has an ordinance now before the City Council asking for a franchise, is meeting with favor. H. E. Smith is secretary of the company.

SIOUX CITY, IA.—The Iowa Union Telephone Company will put in telephone connections between this city and Pierson and a long-distance telephone will be put in at the latter place. The town will be connected with Kingsley and Correctionville.

RALEIGH, N. C.—The Interstate Telephone & Telegraph Company has obtained franchises at the more important cities and towns in North Carolina, and has arranged to connect Raleigh, Goldsborough, Winston, New Berne, Charlotte and other places.

TOPEKA, KAN.—Capitalists of St. Joseph, Kansas City and other towns have organized a telephone plant in Topeka, with a capital stock of $2,000,000. It is known as the National Long Distance Telephone Company, and will combine all the other companies, except the Bell.

CLEBURNE, TEX.—The Cleburne Telephone Company's stockholders have elected the following officers and directors: President, F. Y. Brown; vice-president, J. P. Somonos; secretary and treasurer, W. P. McFarland. The Southwestern Telephone Company has a representative in Cleburne getting up an exchange.

MEMPHIS, TENN.—At a meeting of City Council a contract was closed with the Memphis Telephone Company, a concern working in connection with the American Telephone Company, for the establishment of another telephone system in Memphis. Over $100,000 will be expended in putting in the new plant. J. C. Neely, Jr., will be president of the new company.

ELECTRIC LIGHT AND POWER.

ASTORIA, ILL.—The work of excavation for the new electric light plant building has commenced.

BELLEVILLE, O.—Mr. Gardner, of Orrville, is to put in an electric lighting plant at this place at once.

BELLEFONTAINE, O.—The City Council has decided to purchase a steam engine to run the electric light plant.

CYNTHIANA, KY.—The Cynthiana Electric Light Company has been organized with a capital stock of $10,000.

TOPEKA, KAN.—The City Council is considering the purchase of new machinery for the city electric light plant.

TAMAQUA, PA.—The streets of this borough are to be lighted by electricity with 80 lamps, at an annual expense of $5,000.

SEA CLIFF, L. I., N. Y.—A special election will be held Sept. 10 to vote on the question of lighting the village by electricity.

ESCANABA, MICH.—At a special election, held Aug. 17, the city was authorized to purchase an electric light plant for $70,000.

JACKSON, TENN.—At an election held Aug. 22, the project to issue bonds for establishing an electric light plant was defeated.

SPRINGFIELD, ILL.—Arrangements are now being made for the installation of a new electric light plant at Reisch Bros.' brewery

BROCKTON, MASS.—The Brockton Common Council has passed an ordinance providing for the laying of conduits for electric wires.

EATON RAPIDS, MICH.—At a special election a measure for bonding the city in the sum of $35,000, for an electric light plant, was carried.

HUBBARD, O.—Council has passed a resolution to bond the town for the sum of $5,000, for the purpose of erecting an electric light plant.

HAWKINSVILLE, GA.—On Aug. 20, by a unanimous vote, the citizens of Hawkinsville voted for a water works and an electric light plant.

EUREKA, ILL.—The city has made arrangements with the Eureka Brick, File & Electric Company to furnish 20 arc lights, at the rate of $75 per month.

AVOCA, PA.—A charter has been granted to the People's Electric Light, Heat & Power Company, of Avoca, Luzerne County, having a capital of $25,000.

LOS ANGELES, CAL.—It is proposed to transmit the almost unlimited power of the Kern River, 100 miles distant, to this city by means of electricity.

CARROLLTON, ILL.—H. T. Raney, H. C. Henney, S. A. Simpson and E. L. Simpson propose to put in an electric light plant at this place for commercial lighting.

SEATTLE, WASH.—The City Council has decided to call for bids for lighting Elk, Holly and Thirteenth Streets, at an expenditure not to exceed $100 per month.

CHESTER, PA.—The contract for lighting the streets, alleys, etc., of the city of Chester has been awarded to the Beacon Electric Light Company, of Chicago, Ill.

LEE, MASS.—A meeting of Lee capitalists and mill owners was held Aug. 20 to consider the project of establishing an electric plant to furnish power to the various mills.

COLUMBIA CITY, IND.—The City Council has given to Ruch Bros. a 10-year franchise to light the city, the franchise to date from the expiration of the present franchise, which is March 5.

SENECA FALLS, N. Y.—At a regular meeting of the Board of Trustees, it was ordered that the clerk be instructed to advertise for bids for street lighting, to be presented Sept. 1. T. J. Yawger is president.

ROCKFORD, ILL.—Frank B. Rea, of Chicago, has been engaged by the City Council, as electrical engineer, to draw the plans and superintend the construction of the new city lighting plant, to be put in at a cost of $60,000.

SANTA ROSA, CAL.—It is proposed to install a water power electrical plant of from 2,000 to 5,000 hp in the canyon near Healdsburg, the electric current to be transmitted to Santa Rosa, via Healdsburg and Winsor.

OELWEIN, IA.—This city has made an offer to the Independent Electric Light Company of a $10,000 bonus if they will move their plant here. Independent has just finished a municipal plant, so that it is expected the offer will be accepted.

MANKATO, MINN.—Mankato has voted an appropriation of $10,000 for an electric light plant, to be owned by the city. Prof. George D. Shepardson, of the Department of Electric Engineering, at the University, has been employed to draw plans and specifications for the new plant.

BELOIT, KAN.—Sealed proposals will be received at the office of the State Industrial School for Girls, Sept. 12, for a system of electric lighting, to be executed in accordance with plans, details and specifications prepared by J. C. Holland, state architect. John Seaton is president of the Board of Public Works.

MAHANOY CITY, PA.—A charter has been applied for by Hon. D. D. Phillips, of Gordon; Dr. C. S. Schomo, of Ashland, and Andrew Comrey, Ephraim Barlow and Harrison—all of Mahanoy City, for the Butler Light, Heat & Power Company, which will distribute electric power in Butler Township.

OSBORN, O.—Sealed proposals will be received Sept. 16 for furnishing all labor and material required for the construction of an electric light system and a water works system, according to plans, etc., on file in the office of Corporation Counsel, O. B. Kauffman. Wm. G. Moler, Bushnell Building, Springfield, is consulting engineer.

ST. CLAIR, PA.—Sealed proposals will be received by the borough of St. Clair, until 7 p. m., Sept. 3, for furnishing everything necessary to complete the electric light plant, not included in the original specifications for engines and dynamos. The right is reserved. Specifications on application to the town clerk or to Julius Schlump, superintendent electric light department.

THE ELECTRIC RAILWAY.

SUFFOLK, VA.—Suffolk is desirous of having an electric street railway.

HUDSON, N. Y.—Ground has been broken for the extension of the Hudson Electric Railway to the Fair Grounds.

DETROIT, MICH.—A company has been organized to build an electric road from Detroit to Port Huron, a distance of 65 miles.

KNOXVILLE, TENN.—The Knoxville Electric Railway Company will expend $50,000 in reconstructing its system. J. B. Duncan is receiver.

TRENTON, N. J.—An ordinance giving the Trenton Passenger Railway Company a franchise to extend its tracks was passed at the last meeting of the Council.

COLLEGE HILL (CINCINNATI STATION), O.—The Cincinnati Street Railway Company has received a 20-year franchise to construct an electric road to College Hill.

FREDERICK, MD.—The board of directors of the Frederick & Middletown Electric Railway have decided to order their engineers to proceed with making surveys for the road.

MIDDLETOWN, CONN.—Superintendent Goss has stated that the reports which have appeared in the papers that the electric road to Cromwell will be built are without foundation.

MT. CARMEL, PA.—A six-mile railway from Schuylkill Haven to Pottsville and another covering a similar distance from Minersville to Heckscherville and Taylorsville are to be built.

AXTON, N. Y.—Hon. John P. Badger has appeared before the Railway Commission at Albany to advocate the granting of the right to build the railway from Axton to Long Lake.

BRUNSWICK, GA.—The Brunswick Street Railway Company will issue $30,000 in bonds to be used to change the motive power to electricity. W. A. Jester, Macon, Ga., is general manager.

PHILADELPHIA, PA.—The Moyamensing Avenue & Penrose Ferry Passenger Railway Company has at last received permission to lay its road, and the work of construction will be commenced at once.

FRANKLIN, PA.—The opening of the county bridges to the street railway companies by the commissioners furnishes great possibilities for the future, among which is an electric line between Franklin and Oil City.

COLUMBIA CITY, IND.—The county commissioners of Whittey County have granted the Everett Lake electric road the right of way to the county line. It is intended to connect Fort Wayne and Columbia City.

ROCHESTER, N. Y.—At a regular meeting of the Common Council an application was received from the Rochester Railway Company for a franchise to construct and operate a street car line through certain streets.

COHOES, N. Y.—Workmen are making wire connections on the D. & H. Ry. bridge at Green Island, with the rails of the Troy City Railway, preparatory to the equipping of the Troy & Cohoes White Line with electricity.

LOUISVILLE, KY.—Arrangements are being made to build an electric road between Louisville and Fairfield. Thomas Gilmore and B. F. Gardner are interested. The company will be incorporated with a capital of $200,000.

BLACKSTONE, MASS.—A petition is to be presented to the Blackstone Valley Street Railway directors by the residents of Millbury Avenue, asking that corporation to build a railway through Millbury Avenue to Worcester.

ANGLESEA, N. J.—Mayor Frank Smith, John L. Burk and Wilson Banks, of Holly Beach, and Councilman George Ent, of Anglesea, will form a company to build a trolley road, connecting Anglesea, Wildwood and Holly Beach.

ORCHARD LAKE, MICH.—The Town Board has granted to J. Summer Rogers, Seymour Brownell and Wm. G. Hinman a franchise to build through the town of West Bloomfield, a street railway connecting with the lines of Detroit.

NEW BRUNSWICK, N. J.—Council will meet for the purpose of adopting the ordinance which will be presented by the Street and Roads Committee, giving the Brunswick Traction Company rights through the streets of New Brunswick.

PORTLAND, ME.—At a meeting of the Board of Aldermen a petition was presented by the Portland Railway Company requesting permission to locate, construct and operate single tracks for its street railway. E. A. Newman is general manager.

ROCHESTER, N. Y.—Surveys are being made for a new trolley road from Niagara Falls to Rochester. The road will not enter Lockport, but is projected through Gasport, reaching the Ridge Road near Johnson's Creek, and thence to Rochester.

PITTSBURG, PA.—It is reported that the Second Avenue electric road contemplates expending $1,000,000 in extending its lines to towns adjacent to the city. T. B. Hutchinson, Francis J. Torrance, Arthur Kennedy and A. E. Townsend at present control the line.

BOWLING GREEN, O.—J. R. McKnight, president of the Bowling Green Electric Light Company, has been granted a franchise to build and operate an electric road in said city, and has secured a right of way from Bowling Green to Perrysburg, where he will connect with the Toledo & Maumee Valley belt line.

SOUTH FRAMINGHAM, MASS.—The Milford, Holliston & Framingham Electric Railway Company has applied for a franchise to the towns through which it will operate its new road from Milford to South Framingham. The Worcester Construction Company will build the line, which is expected to be open before January, 1896.

GREENSBURG, PA.—The Greensburg-Jeannette link of the trolley road between the former place and Pittsburg will be completed next month. A tract of land comprising 100 acres has been purchased by the trolley company three miles from Greensburg, and is being laid out as a park. A handsome

pavilion has been erected and a dam is being constructed for the purpose of forming a lake in the grounds.

ST. GEORGE, S. I., N. Y.—It is reported that the Midland Company has been reorganized, and that preparations will be commenced at once for transforming the old horse railway in West Brighton and Stapleton and extending the lines to other important points. The president is H. C. Hickliffe, the brewer, of Paterson, N. J.; vice-president, Benjamin B. Throop, of Scranton, Pa.; treasurer and general manager, W. B. Rockwell, of Scranton, Pa.

FLORENCE, NEB.—It has been decided by the City Council of Florence that the municipality will hold a special election, Sept. 17, to vote on the proposition of giving a bonus of $13,000 to the Omaha & Florence Street Railway Company to aid in the construction of an electric street railway from Ames Avenue to Florence, at a cost of $22,000, including equipment. V. G. Langtry, Walter G. Clark and Fred Parker are the chief promoters of the scheme.

FORT WAYNE, IND.—Fort Wayne, Maysville, Hicksville, Farmer Centre William Centre and Bryan will be connected by an electric road. The subscribers to articles of incorporation include F. N. Morton, president of the First National Bank of Hicksville; J. B. McCullough, a banker and capitalist of Fort Wayne, and John H. Hart, of Hicksville. The capital is $50,000. The road will be 42 miles in length, and the estimated cost of construction and equipment between $500,000 and $700,000.

WORCESTER, MASS.—About 20 land owners living in the vicinity of Rice Square met at the store of Charles H. Rice recently to discuss the project of a new electric railway between Millbury and Worcester. Thomas F. Egan presided at the meeting. A committee was appointed to confer with the directors of the new Blackstone Valley Company and learn from them what they are willing to do toward the road. The committee consists of E. C. Higgins, Elias Sprague, Elmer Sprague and Charles S. Rice.

WASHINGTON, PA.—An electric railway scheme of large proportions has been projected by Pittsburg men, who are at the head of the Second Avenue traction line. The present terminus of the Second Avenue line is McKeesport, and the new project is to extend the line on up the Monongahela to Brownsville, then over the National Road to Washington, and on down the pike to Wheeling and up the Ohio Valley to Pittsburg. T. B. Hutchinson, Francis J. Torrance, Arthur Kennedy and H. A. Townsend, of the Washington Traction Company, are interested.

PHILADELPHIA, PA.—The Philadelphia Traction Company will soon put on three postal cars. Four new cars for trolley parties are also to be added to the equipment. The new cars have been built especially for trolley parties, and are all of the same size and design. They are reconstructed from the largest and best of the old cable cars, though little more than the frame of the old cars remain. The first car came out of the shop last week and the other three will be finished in a few days. The present car is 34 feet long and is mounted on double trucks. It has an aisle in the middle and is provided with reversible cane seats. A bronze rail at the sides prevents accidents from persons leaning or falling out. There is no foot-board at the side on which the more frolicsome spirits of trolley parties can ride. The car has been named "Trilby," and the word is spelled in letters of fire on the transom at each end. Its decorations are very artistic, being entirely of green and white lights, arranged on hangers of green and white China silk. There are more than 400 lights, inside and out, and the effect is beautiful.

THE STANDARD ELECTRIC COMPANY, of Chicago, is contemplating the removal of its plant from that city to some point nearby where more room can be secured for its increasing business. Desplains, 18 miles from Chicago, has offered a bonus of $65,000 for the location of the plant at that place, and other cities, including Kankakee, are contending for its possession.

"THE BOILER REVIEW" is the name of a periodical publication issued by the Hogan Boiler Company, Middletown, N. Y., of which the fourth number has appeared. While frankly devoted to the particular interests of the Hogan boiler, yet much general technical information of interest to all boiler users is contained therein. The editorial department is well conducted, and, in fact, would be creditable to any technical publication.

TELEPHONE CABLES.—The Okonite Company, 13 Park Row, New York, is making two immense cables for the New York Metropolitan Telephone Company, to be placed under the Hudson River. The same company recently manufactured two similar cables to connect New York with Brooklyn, and it is just finishing a cable three miles long, made all in one piece and covered with lead armor, which will be shipped to Lenox, Mass., where it will be laid in the subway.

A FLATTERING SUCCESS.—The Beacon Lamp Company, of Boston, Mass., reports that it met with flattering success with the 11,000 lamps of its make used in the recent Knights Templars' decorations. Mr. J. R. Masury, electrician of B. F. Keith's new theatre, reported that he used three makes of lamps in his Knights Templars' decorations, two thirds of which were of the Beacon make, and in a four-hour test but one Beacon lamp was lost, while 40 and 200, respectively, of the other makes were burned out. The conditions under which the lamps were used were very trying, owing to the intense heat due to their close grouping. The Beacon Lamp Company are justly proud of this result

MACHINE TELEGRAPHY.—Mr. Patrick Delany, in a pamphlet on the "Delany System of Machine Telegraphy," refers to the near approach of the day when cheap telegraphy will enable letters to be telegraphed instead of being carried by train. A system of Mr. Delany's invention, designed to advance this end, is described and its many advantages pointed out. An estimate is contained in the book giving the cost of the installation of the Delany automatic system, of the operating expenses, which show that with a sufficient business to keep the lines occupied the transmission of letters by telegraphy is entirely practicable, the fare proposed being 50 cents for 15 words and one cent for each additional five words.

THE BALL & WOOD COMPANY, 15 Cortlandt Street, New York, reports that never in the history of its business has it had so many orders on its books as at present. This condition of affairs has compelled it to make not only a large addition to its works in building a new boiler house and rearranging its steam plant, but also in the purchase of more large tools. Recent orders include engines for Milwaukee, Wis.; Terre Haute, Ind.; McGregor, Ia.; Helena, Mont.; Denver, Col.; Colorado Springs, Col.; New Orleans, La.; Altoona, Pa.; Wilkesbarre, Pa.; Flatbush, N. Y., beside a large number for the new buildings now going up in New York City. Both from its Chicago and New York offices this company reports some stiffening in prices, and altogether it is confident that the improvement of business will continue.

Trade and Industrial Notes.

CHAS. A. SCHIEREN & CO., of New York, Boston, Philadelphia and Chicago, among recent foreign sales report an order for three 26-inch double perforated electric belts, 105 feet long each, for an electrical plant at Rouen, France.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street, New York. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 27, 1895.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

545,042. HYSTERESIS COMPENSATOR; B. Ardank Abakenowicz, St. Maur, France. App. filed March 17, 1893. A method of correcting hysteresis in electromagnetic apparatus, which consists in employing in such apparatus a main and an auxiliary magnetic circuit and neutralizing the effect of the residual magnetism of the first circuit by that of the other.

545,069. ELECTRIC ANNUNCIATOR; G. J. Galbraith, Boston, Mass. App. filed April 27, 1895. An annunciator composed of a support, a solenoid having a hollow core, a sliding armature, a stop pin, a multi-armed drop having the face, arms and an angle piece arranged to have the movements of a sliding armature controlled.

545,070. UNDERGROUND ELECTRIC RAILWAY; D. F. Graham and W. P. Allen, Springfield, O. App. filed June 21, 1894. The combination of a conductor supported in a conduit, a traveling contact device, switches moved by the said device to supply current to branch wires which make contact with the said traveling device.

545,073. TROLLEY; J. L. Hanson, Omaha, Neb. App. filed June 4, 1895. The combination of a base or plate with a hub revolvably held thereon, and extending arm, ears, and a trolley pole secured to the ears, an arm having mounted adjustably upon it a sleeve, and adjustable sleeves for the trolley pole, and a pole secured to the arm-sleeve and another secured to the pole-sleeve, and a spring secured to the arm and pole sleeves.

545,076. THERMOSTAT; G. Hill, New Brunswick, N. J. App. filed Jan. 3, 1895. Combination of a thermostatic strip, a box carrying contacts and means for adjusting the box, together with circuit connections.

545,091. ELECTRIC GAS-LIGHTING APPARATUS; J. W. Palmer, New Hampshire. App. filed Jan. 9, 1895. The combination of a plate-piece affixed to an oscillating gas-cock, and adapted to carry the vibrating electrode constructed with three arms, one to be affixed to the plate, one to carry the wiping electrode, and the other for connection with the operating wire.

545,111. MEANS FOR SYNCHRONIZING ELECTRIC MOTORS; E. Thomson and E. W. Rice, Swampscott, Mass. App. filed March 8, 1893. The combination of a plurality of continuous-current motor armatures having windings connected to both collector rings and commutator segments, receiving continuous current from an external source and rotated thereby; mains independent of any outside source connecting the collector rings and transmitting current when the speed of the armature is different.

545,127. ELEVATOR INDICATOR; L. Malm, Cleveland, O. App. filed Jan. 5, 1895. The combination of a segmental plate having electric lamps secured thereto and numbered consecutively of a centrally pivoted index finger and means whereby the lamps will glow as the indicator points to them.

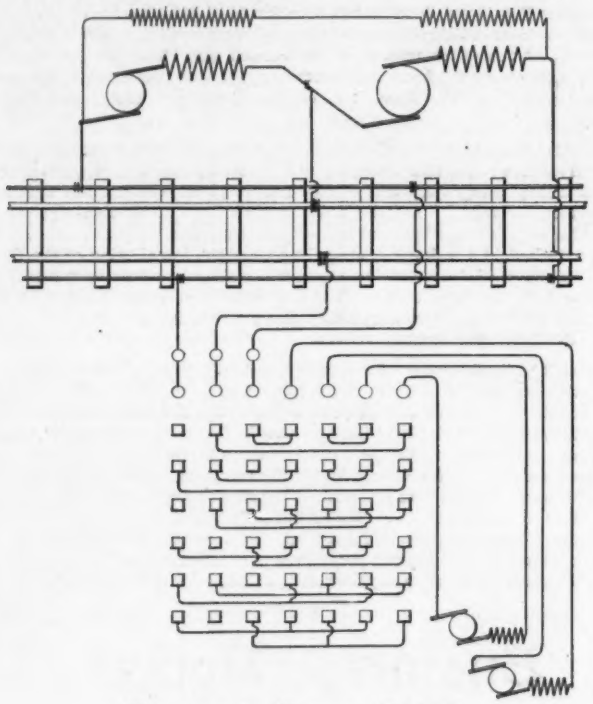
545,141. FIRE ALARM BOX; T. Walsh, Montreal, Can. App. filed April 12, 1895. A box having locking mechanism, an automatically operated grip adapted to open and close, and connections between operated grip adapted to open and close, and connections between the same and the locking mechanism whereby the movement of the latter to unlock the box will close the grip.

545,151. INSULATED SUPPORT FOR TROLLEY WIRES; F. X. Cicott, W. J. Belcher and F. C. Billings, New York, N. Y. App. filed April 22, 1895. The combination of an insulator stud adapted to support a trolley line carrier, a protector for the same having a flaring lower portion, a separate yoke provided with means for connection with a guy wire, and adapted to encircle the lower flaring portion of the protector, and be wedged upon it.

545,149. ELECTROMAGNETIC YOOL; C. F. Carpenter, Louisville, Ky. App. filed Aug. 20, 1894. The combination of a helix, an iron exterior casing, an iron yoke, a fixed electromagnet and a magnet held in balance between two elastic forces.

545,158. ELECTRIC RAILWAY; J. C. Henry, Westfield, N. J. App. filed April 20, 1895. A railway system consisting of an arrangement of circuits leading from the terminals of dynamos having different E. M. Fs., motors in traveling connection with said circuits, and a switch arranged to connect said motors with the circuits from either or both sides.

545,187. TROLLEY-LINE CLAMP; W. J. Belcher, Hartford, Conn. App. filed April 11, 1895. A clamp consisting of a lower and upper member and having an opening intermediate of the lower end, and a clamping jaw adapted to extend around the jaw of the upper member, and a threaded stud constituting a wedge to enter and expand the said divided screw-threaded sleeve in the receiving sleeve.



No. 545,158.—ELECTRIC RAILWAY.

545,191. TELEPHONE HOLDER AND CUT-OFF; A. F. Boardman, Somerville, Mass. App. filed Jan. 2, 1894. A telephone switch consisting of a receiver, a clamp therefor comprising a trough and a spring adapted to grasp and hold the receiver, telephone and call circuits; a spindle operated by inserting the receiver into and withdrawing it from the said clamp to open or close the circuits.

545,204. CONDUIT ELECTRIC RAILWAY; C. H. Johnson, San Jose, Cal. App. filed Feb. 23, 1894. The combination of a conduit, an electric conductor in the bottom thereof, and a trolley pole attached to the bottom of the car and adapted to make contact with the said conductor through the slot in the conduit.

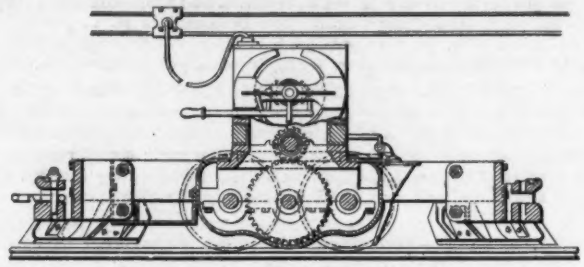
545,208. UNDERGROUND ELECTRIC RAILWAY; Emma E. Moore, Chicago, Ill. App. filed Nov. 16, 1894. A conduit consisting of a U-shape in cross-section, having two separate conduits located in the two vertical side walls of the section, and each having its upper portion contracted and provided with a slot for the passage of a trolley pole.

545,253. COMBINED TELEPHONE RECEIVER SUPPORT AND SWITCH; G. F. Shaver, Yonkers, N. Y. App. filed Dec. 6, 1894. The combination of a fixed post and a pivoted lever provided with contact points, the post and the lever being so set as to form a lock where the switch is in one extreme position, and so that their outer ends are brought nearly together when it is in another extreme position, and a telephone pivoted whereby it is sustained by the support and operates the switch.

545,282. MEANS FOR INDICATING COINCIDENCE OF PHASE OF TWO ALTERNATING OR POLYPHASE CURRENT MACHINES; J. H. F. Gorges, Berlin, Ger. App. filed April 4, 1894. The combination of two alternating or multiphase current machines, each provided with an auxiliary coil, a potential indicator, a switch and interposed connections between the coils and the switch; a direct reading current indicator, a second switch and interposed connections between the coils and the said second switch.

545,296. ELECTRIC CONDUIT; C. J. Kintner, New York, N. Y. App. filed March 16, 1893. A system of interior or house conduits having means for forcing air through conduits and additional means located near the electrical translating devices for regulating the flow of air at points near them, whereby improved insulation is effected in the conduits.

545,347. COMMUTATOR OR COLLECTOR BRUSH; C. L. Coffin, Detroit, Mich. App. filed Feb. 5, 1895. A commutator brush consisting of a strip of sheet metal having a solid non-perforated portion and a perforated portion having a continuous edge.



No. 545,404.—ELECTRIC MINE CAR.

545,357. ELECTRIC SIGNALING DEVICE; W. Gillette, New York, N. Y. App. filed July 5, 1894. A main circuit having a main, a local and a transmitting battery combined with an alarm in the local circuit; a receiver, transmitter, a contact maker for switching the main circuit out of action and the local circuit into action, and contact makers for switching the transmitter battery and the receiver into the main circuit.

545,358. TROLLEY CONTROLLER FOR ELECTRIC RAILWAYS; L. W. P. Gray and P. G. Doescher, New Orleans, La. App. filed May 23, 1895. A controller consisting of a rope fastened to the end of the car and to the trolley pole, an independent rope traversing the top of the car from end to end and carried over pulleys at the ends, the said rope being detachably connected at one end to the rope on the trolley pole at the rear end of the car and carried through the latter longitudinally, its forward end being in reach of the motorman.

545,359. ELECTRIC ARC LAMP; H. T. Harrison, London, Eng. App. filed Nov. 19, 1892. The combination of a frame having telescopic side bars, a lower cross bar carrying a carbon holder, and supporting pulleys over which cords are attached to the said carbon holders; a magnet core and a friction block carried by said core between and adapted to engage said pulleys.

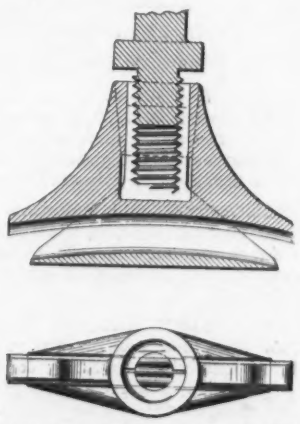
545,390. SECONDARY BATTERY; I. A. Timmis, London, Eng. App. filed Feb. 28, 1895. An element for secondary batteries consisting of a thin sheet of metal bent into folds or plaits and having linear indentations parallel to each other and intersecting the faces of the plaits at an acute angle to the lines of the latter.

545,393. GUARD AND GUIDE FOR ELECTRIC TROLLEYS; J. R. Trisler, Westwood, O. App. filed June 1, 1895. A trolley having a guard above and a guide in back, both combining to hold the wheel up against the wire and prevent it from slipping either up or down or sideways.

545,402. TELEPHONE AND RETURN CALL SYSTEM; T. R. Brimner, Baltimore, Md. App. filed Aug. 16, 1894. The combination of two batteries, two automatic electric call bells, a circuit connecting the batteries in opposing polarity normally through the said call-bells, and two pole-reversing devices one at each bell, each arranged in the circuit and capable of making two different connections; a vibrator, and a single stroke between a call-bell and the circuit.

545,404. ELECTRICALLY OPERATED MINE CAR; H. B. Dierdorff, Columbus, O. App. filed Dec. 24, 1889. A car having a frame or body separable in central vertical plane, and having a motor mounted thereon, track wheels and axles mounted in bearings under the frame, and gearing for transmitting power from the motor to the axles.

545,405. SYSTEM OF ELECTRICAL DISTRIBUTION; T. A. Edison, Llewellyn Park, N. J. App. filed Dec. 6, 1886. The combination of a main station, a circuit extending therefrom to a sub-station, a circuit extending from the sub-station supplying translating devices, and means at the sub-station for regulating the generation of current at the main station.



No. 545,187.—TROLLEY LINE CLAMP.

545,416. TELEPHONE. G. F. Shaver, Yonkers, N. Y. App. filed June 8, 1895. A telephone system having a two-wire conversing circuit, conversing apparatus therein, a shunt to shunt out the same, a mouthpiece for the transmitter to operate the shunt, and a permanent grounding branch in which is included a signaling apparatus.